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APPENDIX A: AGENCY CORRESPONDENCE LETTERS

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
BALTIMORE, MARYLAND 21203-1715

REPLY TO
ATTENTION OF

January 20, 2006

Planning Division

Ms. Maricella Constantino
United States Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401

Dear Ms. Constantino:

The U.S. Army Corps of Engineers, Baltimore District (Corps) is updating two existing Integrated Natural Resources Management Plans (INRMPs) for the Delaware National Guard (DEARNG), on their behalf. These INRMPs address natural resources management at the River Road Training Site in New Castle, and the Bethany Beach Training Site in Bethany Beach.

In preparation of the updated INRMP, the Corps will review existing information about natural resources on each facility, revise and augment this information as necessary, and propose appropriate courses of action to improve and protect these resources. The INRMP will be prepared in accordance with appropriate current DOD and National Guard guidance, and will focus on management opportunities in a manner consistent with the mission of each facility. The INRMP will also include a Record of Environmental Consideration in each INRMP, in accordance with the National Environmental Policy Act (NEPA).

In support of this study, the Corps is inviting your participation in the INRMP update process. It is our goal to have an open dialog with your office regarding priorities for natural resources management in Delaware, and in particular at the Bethany Beach and River Road Training Sites.

In addition, the Corps is requesting any information your office may have on the presence of federally protected species of animals and plants listed by Section 7 of the Endangered Species Act (ESA). This request is for the project areas shown in the enclosed figures (Enclosures 1 and 2). A coordination letter has also been sent to the Delaware Department of Natural Resources and Environmental Conservation for information concerning listed species managed under their jurisdiction.

If you have any questions regarding this matter, please contact Ms. Vaso Karanikolis at (410) 962-4995.

Sincerely,

Robert F. Gore
Chief, Planning and Environmental
Services Branch

Enclosures

CF:
PES Reading File

WELLS/nrs/4939/CENAB-PL-E
KARANIKOLIS/CENAB-PL-E
GORE/CENAB-PL-E

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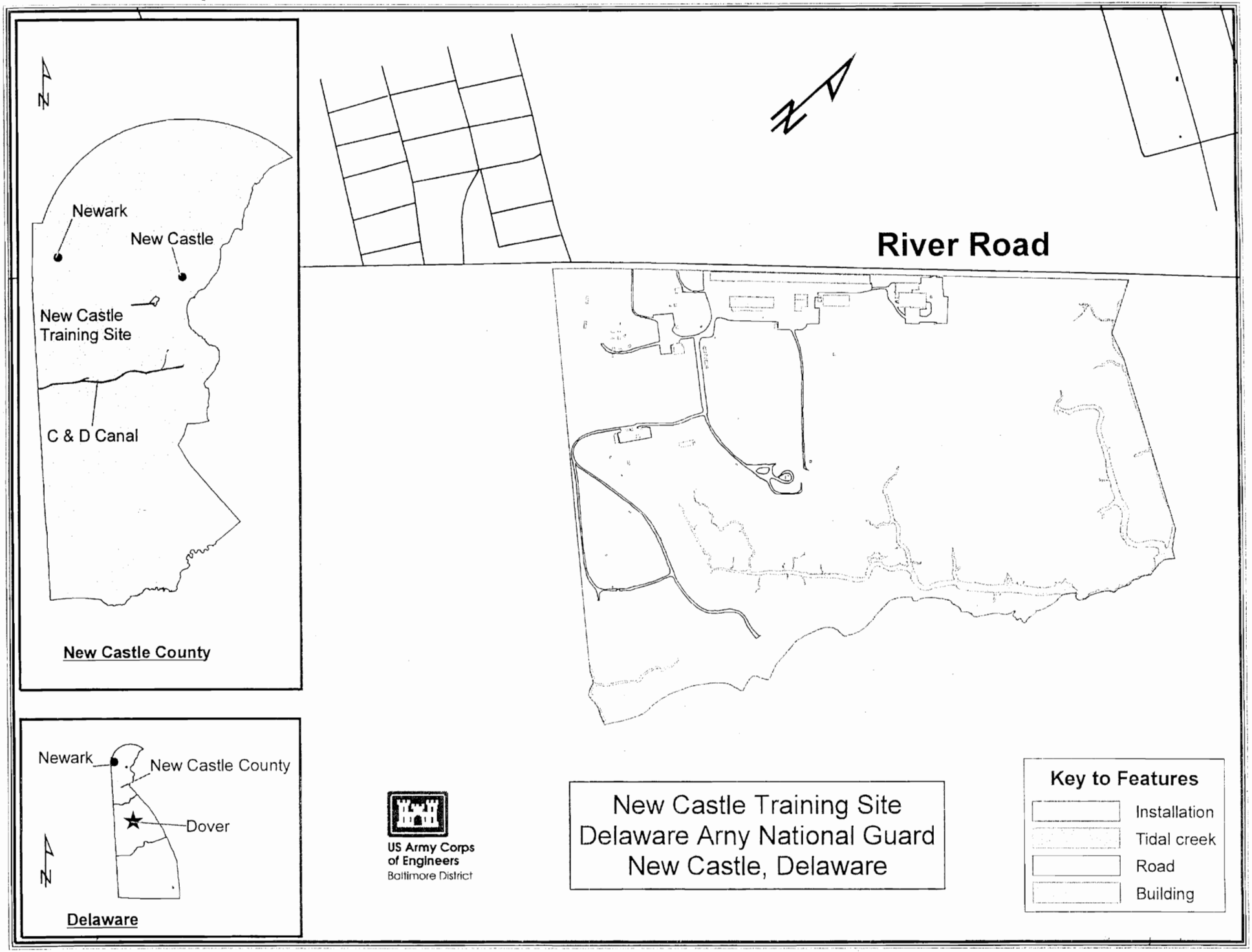
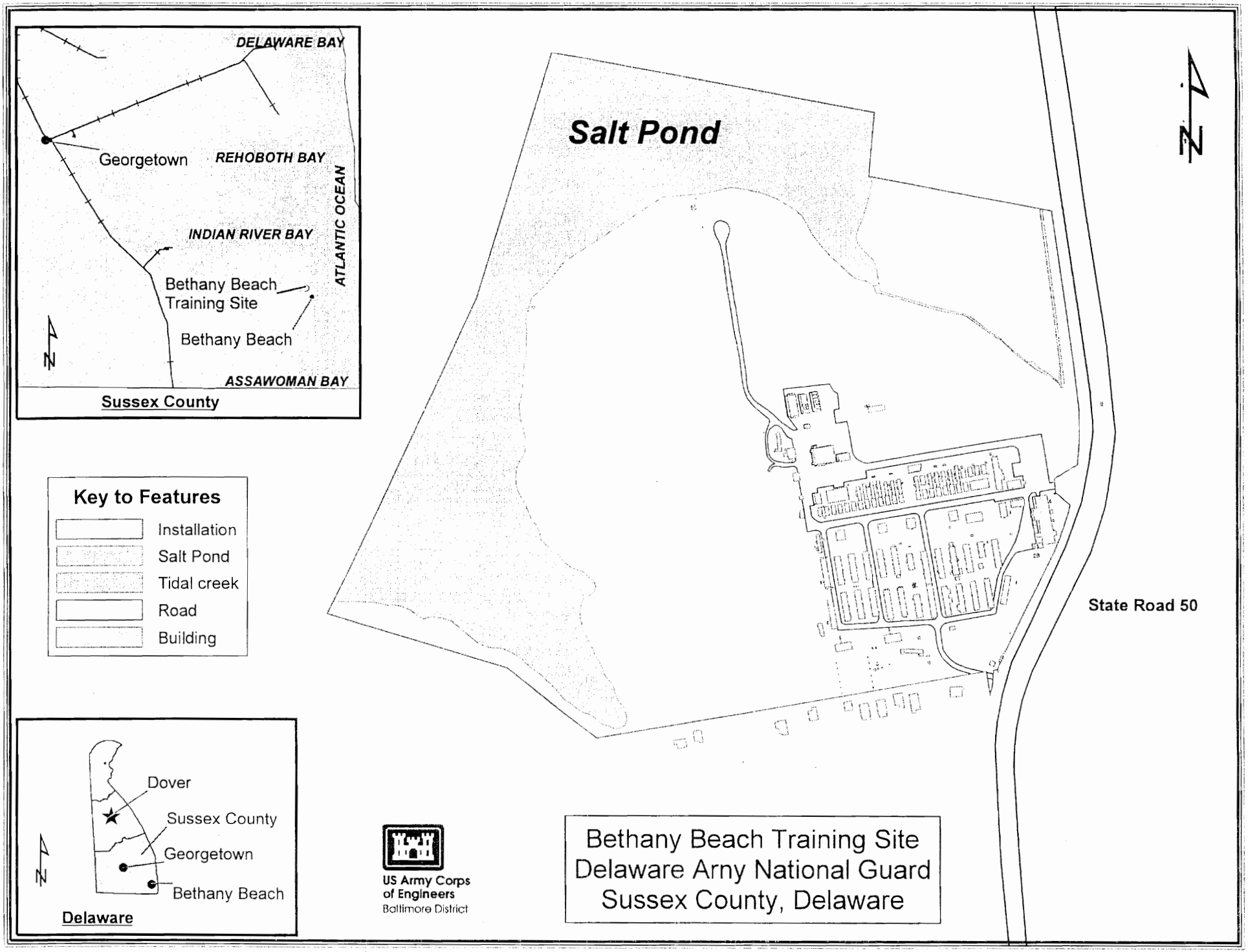


Enclosure 1: Location of River Road Training Site, New Castle, Delaware



Enclosure 2: Location of Bethany Beach Training Site, Bethany Beach, Delaware

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
P. O. BOX 1715
BALTIMORE, MARYLAND 21203-1715

REPLY TO
ATTENTION OF

January 20, 2006

Planning Division

Ms. Karen Bennett
Delaware Department of Natural Resources and Environmental Conservation
Aquatic Resources Education Center
4876 Hay Point Landing Road
Smyrna, Delaware 19977

Dear Ms. Bennett:

The U.S. Army Corps of Engineers, Baltimore District (Corps) is updating two existing Integrated Natural Resources Management Plans (INRMPs) for the Delaware National Guard (DEARNG), on their behalf. These INRMPs address natural resources management at the River Road Training Site in New Castle, and the Bethany Beach Training Site in Bethany Beach.

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In support of this study, the Corps is inviting your participation in the INRMP update process. It is our goal to have an open dialog with your office regarding priorities for natural resources management in Delaware, and in particular at the Bethany Beach and River Road Training Sites.

In addition, the Corps is requesting any information your office may have on the presence of state protected species of animals and plants. This request is for the project areas shown in the enclosed figures (Enclosures 1 and 2). A coordination letter has also been sent to the U.S. Fish & Wildlife Service for information concerning species managed under their jurisdiction.

If you have any questions regarding this matter, please contact Ms. Vaso Karanikolis at (410) 962-4995.

Sincerely,

Robert F. Gore
Chief, Planning and Environmental
Services Branch

Enclosures

CF:
PES Reading File

WELLS/nrs/4939/CENAB-PL-E
KARANIKOLIS/CENAB-PL-E
GORE/CENAB-PL-E

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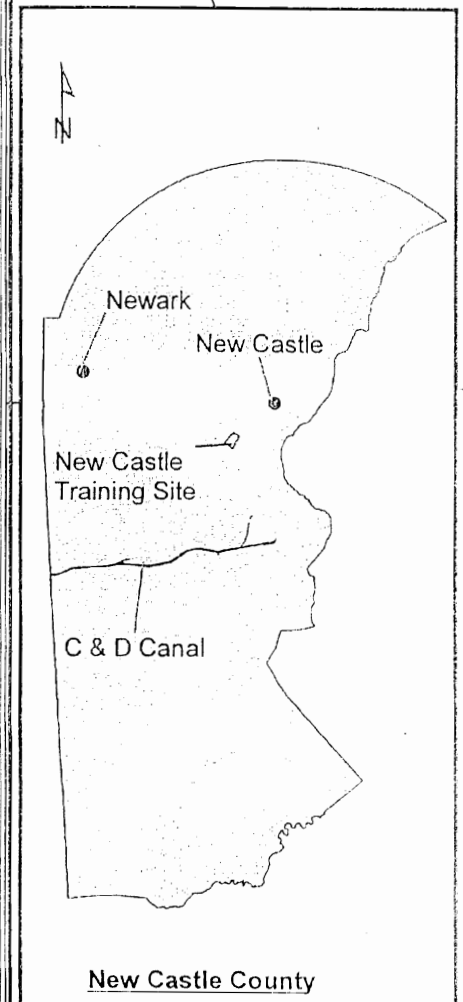
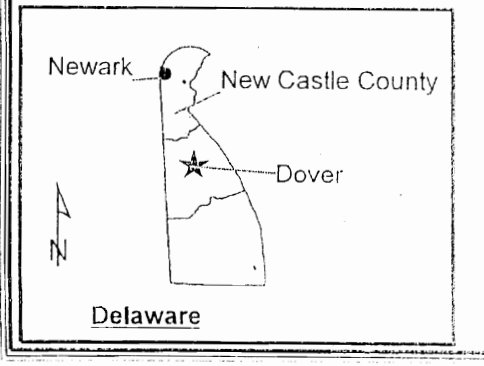
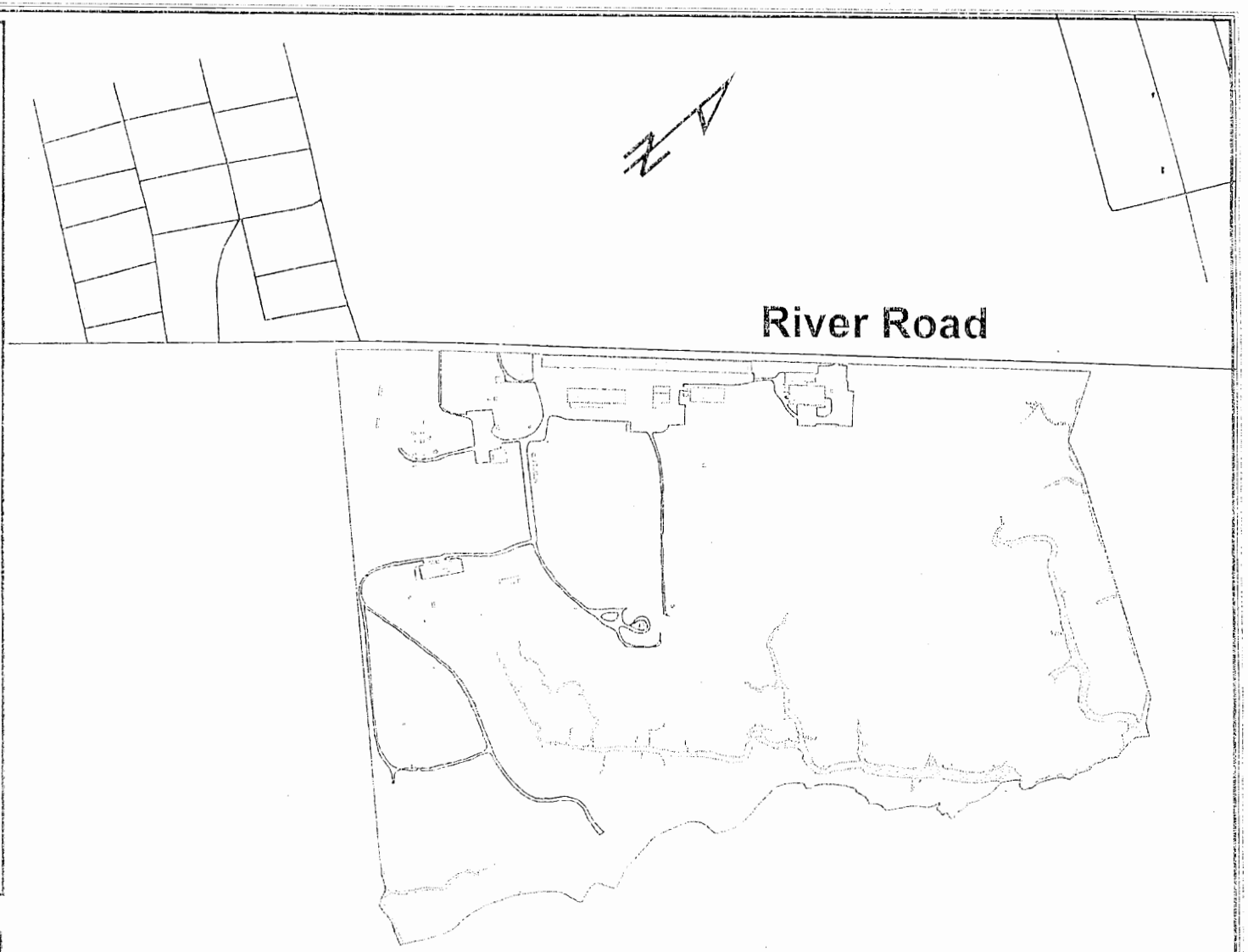




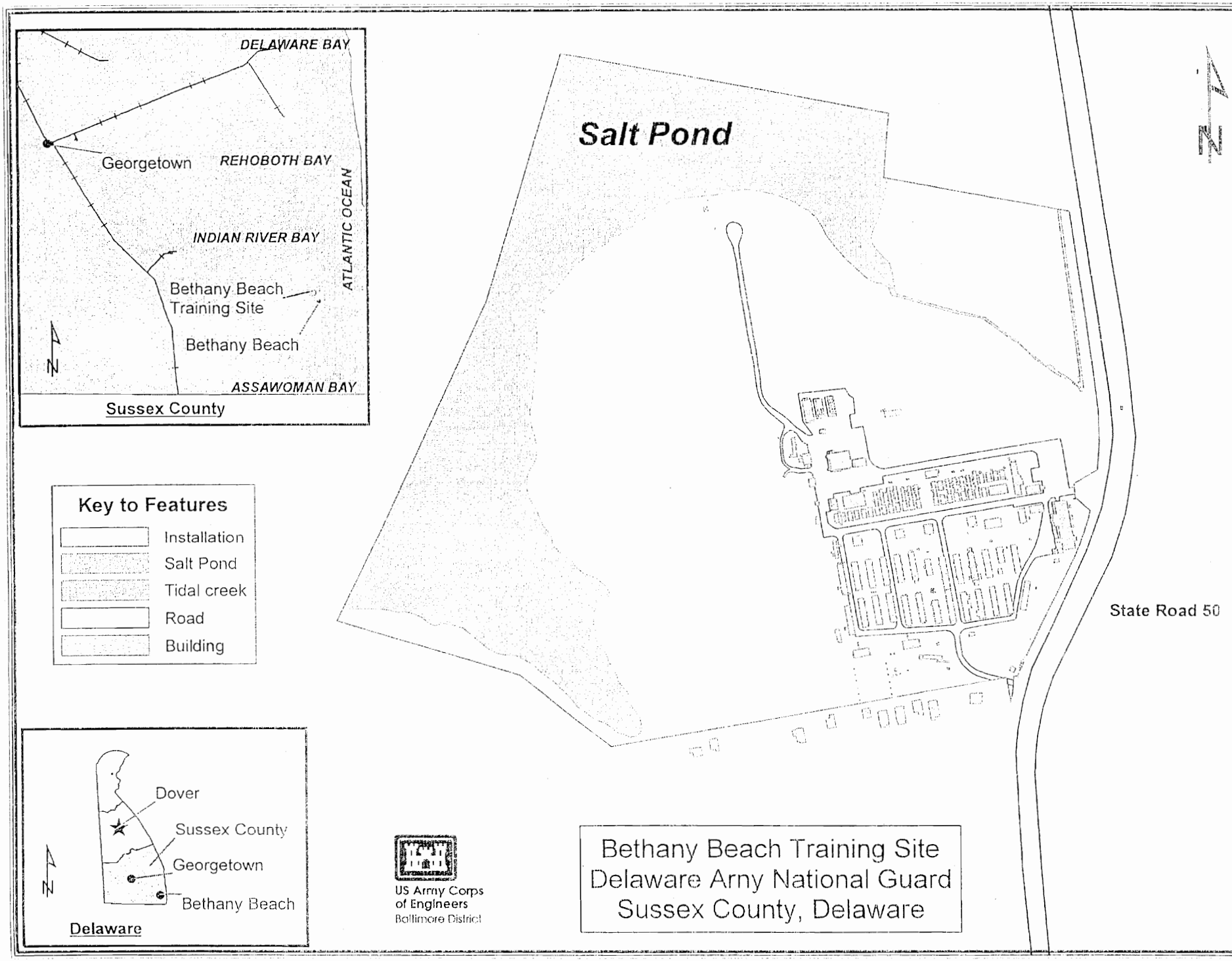


US Army Corps
of Engineers
Baltimore District

New Castle Training Site
Delaware Arny National Guard
New Castle, Delaware

Key to Features
- Installation
- Tidal creek
- Road
- Building

Enclosure 1: Location of River Road Training Site, New Castle, Delaware



Enclosure 2: Location of Bethany Beach Training Site, Bethany Beach, Delaware

VASO - See me on this.

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENTAL CONTROL
DIVISION OF FISH & WILDLIFE
NATURAL HERITAGE & ENDANGERED SPECIES
4876 HAY POINT LANDING ROAD
SMYRNA, DELAWARE 19977
TELEPHONE: (302) 653-2880
FAX: (302) 653-3431

February 28, 2006

Robert F. Gore
Department of the Army
Baltimore District, U.S. Army Corps of Engineers
P.O. Box 1715
Baltimore, MD 21203-1715

RE: Integrated Natural Resources Management Plans (INRMPs)
Bethany Beach Training Site (Bethany Beach) and River Road Training Site (New Castle), Delaware
Applicant: Delaware National Guard

Dear Mr. Gore:

Thank you for contacting the Natural Heritage and Endangered Species program about information on rare, threatened and endangered species, unique natural communities, and other significant natural resources as they relate to the above referenced project.

We would like to participate in the process of updating your INRMPs and respectfully request to survey the wetlands and forested resources at these sites. This is especially important at the River Road site as freshwater wetland inventory and protection is one of our management priorities and we have never surveyed this property. Field surveys will enable us to update the Delaware Natural Heritage Inventory database and provide recommendations on resource protection. Please contact our botanist, Bill McAvoy or our community ecologist, Robert Coxe at (302) 653-2880 to discuss the possibility of a site visit.

Bethany Beach Training Site

A review of our database indicates that there are currently no records of state-rare or federally listed plants, animals or natural communities at this project site. We recommend that efforts to avoid impacts to wetlands on the property be employed as this type of habitat is typically used for nesting and foraging by a variety of wildlife species. Maintaining adequate upland buffers (at least 100ft) is important for protecting water quality within the wetlands.

River Road Training Site

There is a large area of tidal freshwater wetland on this property and efforts to avoid impacting this area should be employed. In addition to the many functions freshwater wetlands provide, a large percentage of Delaware species of special concern are found in this type of system. Overall, the loss of freshwater wetlands and degradation due to adjacent land development is of particular concern in Delaware. Therefore, maintaining adequate upland buffers around the wetlands is extremely important.

This property is adjacent to the Ommelanden Hunter Safety Training Center. This property is owned by the State of Delaware, but is accessible to the public. If you require additional information, please contact the center at (302) 323-5336.

This parcel is also part of the Governor Minner's "Green Infrastructure for a Liveable Delaware" (Executive Order Number Sixty-one; http://www.state.de.us/governor/orders/webexecorder61.shtml). This initiative includes a network of ecologically important natural resource lands of special state conservation interest. Green Infrastructure lands were identified through interpretation of the most important known rare species sites, existing protected lands, 1997 statewide aerial photography, and regional ecological evaluations by the USF&W Service, The Nature Conservancy, the Delaware Natural Areas, Natural Heritage, and Open Space Programs. The lands identified as green infrastructure serve to maintain natural ecological processes protect and support native species, air and water resources, sustain agricultural enterprises, and contribute to the health and quality of life for the citizens of Delaware. Because most of the Green Infrastructure lands are privately owned, it is a voluntary initiative that appeals to the stewardship of private landowners.

We are continually updating records on Delaware's rare, threatened and endangered species, unique natural communities and other significant natural resources. If you have any questions, please contact me at (302) 653-2883 ext. 126.

Sincerely,

Edna J. Stetzar

Edna J. Stetzar
Biologist/Environmental Review Coordinator

vnk → HW

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, MD 21401

March 5, 2006

Mr. Robert F. Gore
Chief, Planning and Environmental Service Branch
U.S. Army Corps of Engineers
Baltimore District
P.O. Box 1715
Baltimore, MD 21203-1715

RE: INRMP for the Delaware National Guard – River Road Training Site, New Castle County and Bethany Beach Training Site, Sussex County, DE

Dear Mr. Gore:

This responds to your letter, dated January 20, 2006, requesting information on the presence of species which are federally listed or proposed for listing as endangered or threatened within the above referenced project area. We have reviewed the information you enclosed and are providing comments in accordance with section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

The federally threatened bog turtle (*Clemmys muhlenbergii*) may be present within the River Road Training Site located in New Castle County, Delaware. Bog turtles primarily inhabit palustrine wetlands comprised of a muddy bottom or shallow water, and tussocks of vegetation. A survey for bog turtle habitat and bog turtles may be appropriate. These surveys should be conducted at any location the Delaware Natural Heritage and Endangered Species recommends. Upon completion, survey reports should be forwarded to both the Service and the Delaware Natural Heritage and Endangered Species Program for review. If you have not already sent a copy of your request for threatened and endangered species information to the Delaware Natural Heritage and Endangered Species Program please do so. Ms. Holly Niederriter can provide further details regarding the distribution of bog turtles in the state of Delaware, appropriate survey techniques for determining the presence of the species, and a list of qualified bog turtle surveyors. Ms. Niederriter may be contacted at (302) 653-2880 ext 121.

Except for occasional transient individuals, no other federally proposed or listed threatened or endangered species are known to exist within the project area. Should project plans change, or if additional information on the distribution of listed or proposed species becomes available this determination may be reconsidered.

This response relates only to federally protected threatened or endangered species under our jurisdiction. For information on the presence of other rare species, you should contact Edna Stetzar of the Delaware Natural Heritage and Endangered Species Program at (302) 653-2883 ext. 126. You may also obtain information on how to make such a request by visiting the Program website at www.dnrec.state.de.us/nhp.

We appreciate the opportunity to provide information relative to fish and wildlife issues, and thank you for your interests in these resources. If you have any questions or need further assistance, please contact Andy Moser at (410) 573-4537.

Sincerely,

G. A. Mos

Mary J. Ratnaswamy, Ph.D.
Program Supervisor, Threatened and Endangered Species

cc: Holly Niederriter, Delaware Natural Heritage Program, Smyrna, DE

APPENDIX B: PLANNING LEVEL SURVEYS (PLSS)

FLORA PLS

The vegetation community assessments at the RRTS 2005 have identified a total of 179 species of plant on the installation. Of these, nine were identified within the Disturbed Forest Edge habitat, 30 were in the Mixed Hardwood-Oak Forest, none were identified within the Mixed Successional Forest, 25 were located within the Red Maple – Sweetgum Successional Forest, 15 were identified within the Red Maple – Blackgum Swamp, 12 were in the Scrub-Shrub Wetland, 40 were identified within the Brackish Tidal Marsh, and 4 were identified within the Brackish Tidal Low Marsh.

		Ecological Community										1999 INRMP Ecological Communities											
Scientific Name	**Common Name**	**Disturbed forest edge**	**Mixed Hardwood-Oak Forest**	**Mixed Successional Forest** (formerly Shrubland)	**Successional Grassland, includes reforested area**	**Red Maple/Sweet Gum Successional hardwood forest**	**Red Maple/Sweet Gum Swamp**	**Scrub/Shrub Wetland**	**Brackish Tidal Marsh** (formerly *Phragmites* BTM)	**Brackish Tidal Low Marsh** (formerly *Spartina* brackish tidal marsh)	**National Plant List Indicator Status**	**Disturbed forest edge**	**Mixed hardwood-oak forest**	**Mowed grass/landscaping** (not done in 2004)	**Shrubland**	**Successional grassland**	**Successional hardwood forest**	**Red maple/blackgum swamp**	**Scrub/shrub wetland**	**Phragmites brackish tidal marsh**	**Spartina brackish tidal marsh**	**Intertidal mudflat** (done as part of BTM in 2004)	**Intertidal unconsolidated shore** (part of BTM in 2004)
Acer negundo	Boxelder	x									FAC+												
Acer rubrum	Red Maple	x	X			X	X				FAC		x		x		x	x	x				
Acer saccharinum	Silver maple						x				FACW	x											
Acorus calamus	Sweetflag								X		OBL												
Agalinis purpurea	Purple Foxglove				x						FACW-												
Agrimonia parviflora	Tall Agrimony											x		x									
Albizia julibrissin	Mimosa											x											
Andropogon glomeratus	Bushy Beardgrass				x						FACW+												
Andropogon spp.	Beardgrass											x				x							
Apocynum cannabinum	Clasping-leaf Dogbane								x		FAC												
Asclepias tuberosa	Butterfly Milkweed															x							
Bartonia spp.	Bartonia															x							
Bartonia virginica	Yellow Bartonia															x							
Bidens laevis	Bur Marigold								x		OBL												
Boehmeria cylindrica	False Nettle																		x				
Carex annectens	Yellowfruit Sedge				x						FACW												
Carex caroliniana	Hirsute Sedge				x						FACU												
Carex crinita	Fringed Sedge								x		OBL												
Carex laevivaginata	Smooth-sheathed sedge								x		OBL												
Carex lurida	Shallow Sedge								x		OBL												
Carex scoparia	Pointed Broom Sedge				x						FACW												
Carex vulpinoidea	Fox Sedge								x		OBL												
Celestrus spp.	Bittersweet											x											x
Cinna latifolia	Slender wood-reedgrass				x						FACW												
Cornus amomum	Swamp Dogwood						x				FACW	x						x	x				x
Cornus florida	Flowering Dogwood	x				x					FACU-		x										
Cornus racemosa	(Gray) Red-panicle dogwood							x			NI												
Crataegus spp.	Hawthorns		x			x	x																x
Dichanthelium spp.	Panic Grass		x						x														
Diospyros virginiana	Persimmon					x					FAC-												x
Eleocharis tennuis	Slender Spikerush				x				x		FACW+												
Eupatorium hyssopifolium	Hyssopleaf Thoroughwort															x							
Eupatorium pilosum	Vervain Thoroughwort				x						FACW												
Eupatorium pubescens	Hairy Thoroughwort				x						NI												
Euthamia graminifolia	Flattop, Goldentop															x							
Festuca spp.	Fescue (Grass)				x									x									
Fragaria vesca	Woodland Strawberry	x			x						NI	x											
Fraxinus pennsylvanica	Green Ash																						x
Gleditsia triacanthos	Honey Locust											x											x
Holcus lanatus	Common Velvetgrass				x						FACU												
Hibiscus muchuctos	Marsh hibiscus								X		OBL									x			x
Ilex decidua	Deciduous Holly						x				FACW												
Ilex opaca	American Holly		x				x				FACU+		x			x	x						
Impatiens spp.	Jewel weed						x		x		FACW												
Iris pseudacorus.	Yellow Water Iris								X		OBL												
Iva frutescens	High-tide Bush								x		FACW+									x			
Juncus canadensis	Canada Rush								x	X	OBL												
Juncus effusus	Softrush				x				x		FACW+												
Juncus tenuis	Slender Rush		x		x						FAC-												
Juniperus virginiana	Eastern Red Cedar																						x
Leerisia orizoides	Rice Cutgrass								X		OBL												
Lespedeza striata	Japanese Clover				x						FACU												
Lindera benzoin	Spicebush	x									FACW-												
Linum intercursum	Sandplain Flax				x						NI												
Liquidambar styraciflua	Sweet Gum		x		x	X	X				FAC		x		x	x	x						
Liriodendron tulipifera	Tulip Poplar		X				x				FACU		x				x						
Lonicera japonica	Japanese Honeysuckle	x				x		x			FAC-	x					x						x
Ludwigia alternifolia	Seedbox				x				x		FACW+												
Lycopodium digitatum	Fan clubmoss		x				x				NI												
Lycopodium obscurum	Rare clubmoss		x				x				FACU												
Lycopodium spp.	Club moss												x										
Lycopus americanus	Water Horehound								x		OBL												
Lythrum salicaria	Purple Loosestrife								x		FACW+												
Malus (Pyrus) sp.	Apple					x								x									
Matteuccia struthiopteris	Ostrich Fern							x			FACW												
Microstegium vimineum	Nepal Microstegium	x	x				x				FAC			x									
Mikania scandens	Climbing Hempweed								x		FACW+												
Morella cerifera	Wax Myrtle, Bayberry								x		FAC	x				x				x			
Morella heterophylla	Evergreen Bayberry															x							

Scientific Name	Common Name	**Disturbed forest edge**	**Mixed Hardwood-Oak Forest**	**Mixed Successional Forest** (formerly Shrubland)	**Successional Grassland, includes reforested area**	**Red Maple/Sweet Gum Successional hardwood forest**	**Red Maple/Sweet Gum Swamp**	**Scrub/Shrub Wetland**	**Brackish Tidal Marsh** (formerly *Phragmites* BTM)	**Brackish Tidal Low Marsh** (formerly *Spartina* brackish tidal marsh)	**National Plant List Indicator Status**	**Disturbed forest edge**	**Mixed hardwood-oak forest**	**Mowed grass/landscaping** (not done in 2004)	**Shrubland**	**Successional grassland**	**Successional hardwood forest**	**Red maple/blackgum swamp**	**Scrub/shrub wetland**	**Phragmites brackish tidal marsh**	**Spartina brackish tidal marsh**	**Intertidal mudflat** (done as part of BTM in 2004)	**Intertidal unconsolidated shore** (part of BTM in 2004)
Nyssa sylvatica	Black Gum		X			x	x				FAC		x					x					
Onoclea sensibilis	Sensitive Fern						x				FACW		x										
Osmunda cinnamomea	Cinnamon Fern		x				x				FACW												
Osmunda regalis	Royal Fern						X				OBL		x										
Panicum virgatum	Switch Grass				x				x		FAC												
Parthenocissus quinquefolia	Virginia Creeper		x			x					FACU		x			x							
Peltandra virginica	Peltandra								X		OBL												
Photinia spp (arbutifolia?)	Chokeberry		x			x	x				FAC/FACW												
Phragmites australes	Phragmites								x	X	FACW	x	x							x			x
Phytolacca americana	Pokeweed											x				x							
Pilea pumila	Canadian Clearweed																						
Polygonum arifolium	Halberd-leaved Tearthumb								x		OBL												
Polygonum punctatum	Marsh smartweed								x		OBL												
Polygonum spp.	Smartweed																			x			x
Pontederia cordata	Pontederia								X		OBL												
Populus deltoides	Eastern Cottonwood										FAC		x				x						
Populus grandidentata	Bigtooth Aspen					x					FACU-												
Populus tremuloides	Quacking Aspen					x					FACU												
Prunus serotina	Black Cherry		X			x					FACU	x	x				x						
Pteridium aquilnum	Bracken Fern												x			x							
Quercus alba	White Oak		X			x					FACU-		x			x	x						
Quercus bicolor	Swamp White Oak		x			x					FACW+												
Quercus coccinea	Scarlet Oak		X								NI												
Quercus falcata	Southern Red Oak		X			x					FACU-		x										
Quercus lyrata	Overcup Oak		x								OBL												
Quercus marilandica	Blackjack Oak		X			x					NI												
Quercus nigra	Water Oak						x				FAC												
Quercus palustris	Pin Oak		x			x	x				FACW												
Quercus phellos	Willow Oak		x				x				FAC+		x				x						
Quercus rubra	Northern Red Oak					x					FACU-												
Quercus velutina	Black Oak						x				NI												
Rhexia mariana	Maryland Meadow Beauty				X						OBL												
Rhexia virginica	Virginia Meadow Beauty				x						OBL				x	x							
Rhus copallina	Winged Sumac											x				x							x
Rhynchospora glomerata	Clustered Beakrush				x						OBL												
Rhynchospora macrostachya	Tall Beakrush				x						OBL												
Rhynchospora sp.	Beakrush															x							
Rosa multiflora	Multiflora Rose	x	x			x					FACU	x			x								
Rubus allegheniensis	Allegheny Blackberry	x			x	X		x			FACU-	x				x							x
Rumex crispus	Curly Dock								x		FACU												
Rumex verticillatae	Swamp Dock				x				x		OBL												
Sagitaria latifolia	Sagitaria								x		OBL												
Salix nigra	Black Willow											x			x								
Sassafras albidum	Sassafras		X			x					FACU-		x				x						
Saururus cernuus	Lizard's Tail								x		OBL												
Schoenoplectus americanus (formerly Scirpus olneyi)	Olney three-square								x		OBL												
Schoenoplectus pungens (Vahl) Palla var. pungens (formerly Scirpus americanus)	Three-square								x	X	FACW+												
Schoenoplectus tabernaemontani	Softstem Bulrush								x		OBL												
Scirpus atrovirens	Green Bulrush				x				x		OBL												
Scirpus fluviatalis	River Bulrush								x	X	OBL												
Smilax spp.	Briars		x			x		x															
Solanum dulcamara	Climbing Nightshade											x											
Solidago graminifolia	Grass-leaved Goldenrod				x						NI												
Solidago rugosa	Wrinkleleaf Goldenrod				x						FAC												
Solidago tenuifolia	Slender Fragrant Goldenrod				x						NI												
Solidago ulmifolia	Elm-leaved Goldenrod				x						NI												
Solidago spp.	Goldenrod								x			x				x							
Sparganium spp	Bur-reed								x		OBL												
Spartina alterniflora	Saltmarsh Cord Grass																				x		
Spartina cynosuroides	Big Cord Grass																				x		
Sphagnum spp	Sphagnum Moss		x		x																		
Thelypteris noveboracensis	New York Fern		x				X				FAC												
Toxicodendron radicans	Poison Ivy		x			x	x	x			FACU	x	x				x						
Tridens flavus	Purpletop Tridens				x						FACU*												
Typha angustifolia	Narrowleaf Cattail								X		OBL												
Typha latifolia	Broadleaf Cattail								X		OBL												
Vaccinium angustifolium	Lowbush blueberry				x						FACU-												

Scientific Name	Common Name	**Disturbed forest edge**	**Mixed Hardwood-Oak Forest**	**Mixed Successional Forest** (formerly Shrubland)	**Successional Grassland, includes reforested area**	**Red Maple/Sweet Gum Successional hardwood forest**	**Red Maple/Sweet Gum Swamp**	**Scrub/Shrub Wetland**	**Brackish Tidal Marsh** (formerly *Phragmites* BTM)	**Brackish Tidal Low Marsh** (formerly *Spartina* brackish tidal marsh)	**National Plant List Indicator Status**	**Disturbed forest edge**	**Mixed hardwood-oak forest**	**Mowed grass/landscaping** (not done in 2004)	**Shrubland**	**Successional grassland**	**Successional hardwood forest**	**Red maple/blackgum swamp**	**Scrub/shrub wetland**	**Phragmites brackish tidal marsh**	**Spartina brackish tidal marsh**	**Intertidal mudflat** (done as part of BTM in 2004)	**Intertidal unconsolidated shore** (part of BTM in 2004)
Vaccinium corymbosom	Highbush blueberry		**x**				**X**	**x**			FACW-												
Vaccinium spp.	Blueberry														x	x							
Vibernum dentatum	Southern Arrowwood		**x**					**X**			FAC	x			x								
Vibernum prunifolium	Smooth blackhaw							**x**			FACU												
Vibernum recognitum	Northern arrowwood					**x**	**X**	**X**			FACW-												
Vitus spp.	Wild Grape							**x**				x			x								
Vitis labrusca	Fox Grape							**x**			FACU	x			x								
X = Dominant, x = non-dominant	**COUNT**	**9**	**31**	**0**	**33**	**25**	**15**	**12**	**40**	**4**		**23**	**19**	**4**	**9**	**20**	**11**	**3**	**3**	**5**	**2**	**0**	**13**
	TOTAL Number of Species:	179										112											
6 species on 2003 DE rare plant list. Possibly 3 misidentified (*V. angustifolium, L. intercursum, and C. racemosa*)																							

FAUNA PLS

Sampling Method

The Corps conducted quarterly observation surveys within representative cover types throughout the installation. These observations were scheduled to provide the most likely chance of seeing the largest variety of plants and wildlife thought to occur within the installation. The quarterly observations were timed and followed standard procedures for avian surveys. Any observed mammals, reptiles and amphibians were noted but not specifically sampled for.

The wildlife observation surveys were conducted in October 2004 (13th through 28th), January 2005 (20th and 21st), May 2005 (24th through 27th) and July 2005 (22nd through 29th). Additional walk through observations were noted during the wetland delineation process in June 2005. The results of the wildlife observation yielded a total of sixty-two avian species, five herptile species (amphibians and reptiles), six mammal species and five invertebrate species.

Birds

The quarterly avian observations yielded diverse results. Several categories of birds merit discussion. Colonial wading birds, forest-interior Neotropical migrant birds, and raptor (birds of prey) species were observed. Several of these species are of state conservation concern.

The installation is located in the Atlantic migratory bird flyway, where the marshes of Delaware Bay serve as refuges for migrating and resident birds, including geese, ducks, and shorebirds. The Supawna Meadows National Wildlife Refuge is located across the river to the east of the RRTS, in Salem County, New Jersey. It provides approximately 2,800 acres of protected habitat areas for migratory birds, white-tailed deer, and a variety of other species. Pea Patch Island, a 312 acre island located to the south of the RRTS, is the site of the largest wading bird nesting colony north of Florida on the East Coast. Colonial wading birds are particularly dependent on habitat available at Pea Patch Island. The RRTS lies within the 9.3 miles diameter focus area of the Pea Patch Island Heronry Special Area Management Plan (SAMP), established under the federal Coastal Zone Management Act (Stephenson, 1998).

Quarterly avian surveys resulted in the observation of three colonial wading bird species. Since the quarterly avian surveys were observational in nature, no species specific detailed survey was conducted. All three wading bird species are state species of conservation concern. Of the three species observed, two species (Great Egret and Great Blue Heron) were seen flying over the brackish tidal marsh. The Great Egret is an extremely rare breeder within the state and the Great Blue Heron is a very rare breeder within the state. Neither of these species were observed landing in the marsh. The remaining species, the Glossy Ibis, was seen within the brackish tidal marsh as a colony and exhibited breeding behavior. Investigations in the observed location revealed several nesting structures. The Glossy Ibis is an extremely rare breeder within the state.

Wildlife Observed at the RRTS (Quarterly Surveys)

F = fall, W = winter, Sp = spring, S = summer

Scientific Name	Common Name	Quarter	Previously Identified
AVIAN SPECIES			
Aegolius acadicus	Northern Saw-whet Owl		X
Accipiter cooperii	Coopers Hawk	Sp	
Accipiter striatus	Sharp-shinned Hawk	W	
Agelaius phoeniceus	Red-winged Balckbird	Sp, S	X
Anas platyrhyncos	Mallard	Sp	X
Anas rubripes	American Black Duck	W	X
Ardea herodias	Great Blue Heron	Sp, S	X
Branta canadensis	Canada Goose		X
Bubulcus ibis	Cattle Egret		X
Buteo jamaicensis	Red-tailed Hawk	W	
Buteo platypterus	Broadwing Hawk	F, W	
Butorides striatus	Green Heron	S	
Cahartes aura	Turkey Vulture	F	
Cardinalis cardinalis	Northern Cardinal	F, Sp, S	X
Carduelis tristis	American Goldfinch	Sp	X
Carpodacus mexicanus	House Finch		X
Carpodacus purpureus	Purple Finch	Sp	
Casmerodius albus	Great Egret	Sp	X
Catharus fuscescens	Veery	Sp	
Catharus guttatus	Hermit Thrush	F	X
Certhia americana	Brown Creeper	W	
Charadrius vociferous	Killdeer		X
Circus cyaneus	Northern Harrier		X
Cistothorus palustris	Marsh Wren	F, Sp	X
Colaptes auratus	Yellow-shafted [Northern] Flicker	S	X
Colinus virginianus	Northern Bobwhite		X
Columba livia	Rock Dove	F	
Contopus virens	Eastern Pewee	Sp	
Corvus brachyrhynchos	American Crow	F, W, Sp, S	X
Corvus ossifragus	Fish Crow		X
Cyanocitta cristat	Blue Jay	F, Sp, S	X
Cygnus olor	Mute Swan		X
Dendroica coronata	Yellow-rumped Warbler	W	X

Dryocopus pileatus	Pileated Woodpecker	F	
Dumetella carolinensis	Gray Catbird	Sp, S	X
Egretta thula	Snowy Egret		X
Falco sparverius	American Kestrel		X
Gavia immer	Common Loon		X
Goethylpis trichas	Common Yellowthroat	Sp, S	X
Haliaeetus leucocephalus	American Bald Eagle	Sp	
Hirundo rustica	Barn Swallow	Sp	X
Hylocichla mustelina	Wood Thrush	Sp	X
Icteria virens	Yellow Breasted Chat	Sp	
Icterus galbula	Baltimore Oriole	Sp	
Iridoprocne bicolor	Tree Swallow	Sp, S	X
Ixoreus naevius	Varied Thrush	S	
Junco hyemalis	Dark-eyed Junco		X
Larus argentatus	Herring Gull	W	
Larus delawarensis	Ring-Billed Gull		X
Meleagris gallopavo	Eastern wild turkey	F	
Melospiza georgiana	Swamp Sparrow	F	
Melospiza melodia	Song Sparrow	F, W, Sp	X
Mimus polyglottos	Northern Mockingbird	Sp, S	X
Molothrus ater	Brown-headed Catbird		X
Myiarchus crinitus	Great Crested Flycatcher	Sp, S	
Nycticorax nycticorax	Black-crowned Nightheron		X
Pandion haliaetus	Osprey	Sp	X
Parus atricapillus	Black Capped Chickadee	F, WS	
Parus bicolor	Tufted Titmouse	W, Sp	X
Parus carolinensis	Carolina Chickadee	Sp, S	X
Passerella iliaca	Fox sparrow		X
Passerina cyanea	Indigo Bunting	Sp	X
Phalacrocorax auritus	Double-crested Cormorant	F, W, Sp	X
Picoides pubescens	Downy Woodpecker	W, Sp, S	
Picoides villosus	Hairy Woodpecker	W	
Pipilo erythrophthalmus	Rufous-sided Towhee	S	X
Plegadis falcinellus	Glossy Ibis	Sp	X
Quiscalus major	Boat-tailed Grackle	F, Sp	
Regulus satrapa	Golden Crowned Kinglet	F	
Riparia riparia	Bank Swallow	Sp, S	
Seiurus aurocapillus	Ovenbird	S	X
Setophaga ruticilla	American Redstart		X

Spizella passerina	Chipping Sparrow	F	
Spizella pusilla	Field Sparrow		X
Sterna caspia	Caspian Tern		X
Sturnus vulgaris	European Starling	Sp	X
Thryothorus ludovicianus	Carolina Wren	S	X
Toxostoma rufum	Brown Thrasher	S	X
Turdus migratorius	American Robin	WS	X
Tyrannus tyrannus	Eastern Kingbird	Sp, S	X
Vireo gilvus	Warbling Vireo	Sp	
Vireo griseus	White-eyed Vireo		X
Zenaida macroura	Mourning Dove	F	
Zonotrichia albicollis	White-Throated Sparrow		X
	HERPTILE SPECIES		
Bufo woodhousii fowleri	Fowler's Toad		X
Cheyldra serpentina	Snapping Turtle		X
Clemmys guttata	Spotted Turtle		X
Coluber constrictor constrictor	Northern Black Racer		X
Elaphe obsoleta obsoleta	Black Rat Snake	Sp	
Hyla crucifer	Spring Peeper	Sp	X
Nerodia sipedon sipedon	Northern Water Snake		X
Rana catesbeiana	Bullfrog	S	
Rana clamitans	Green Frog	Sp, S	X
Rana sylvatica	Wood Frog	Sp	
Terrapene carolina carolina	Eastern Box Turtle		X
Thamnophis sirtalis sirtalis	Common Garter Snake	Sp	
	MAMMAL SPECIES		
Marmota monax	Black-bellied Marmot	S	
Odocoileus virginianus	White-tailed Deer	F, Sp, S	X
Peromyscus leucopus eastii	White-Footed Mouse		X
Procyon lotor	Raccoon	W	X
Sciurus carolinensis	Eastern Gray Squirrel	F, Sp, S	X
Sylvilagus floridanus	Eastern Cottontail Rabbit	W	X
Vulpes vulpes	Red Fox	F, Sp, S	X
	INVERTEBRATE SPECIES		
Callinectes sapidus	Atlantic Blue Crab	S	
Procambarus spp.	Crayfish species	Sp, S	
Odonata	Dragonfly species	Sp, S	
Popillia japonica	Japanese Beetle	Sp, S	
Stagmomantis carolina	Carolina Mantis	F	

The installation, as well as much of the forested portions of the Middle Atlantic Coastal Plain provides habitat for forest-interior Neotropical migratory bird species. Neotropical migrant birds are those species which winter in tropical regions but nest in the United States. While many of these species may be declining in numbers, they are still considered common occurrences by the Delaware Natural Heritage Program (DNHP). These species warrant special consideration primarily due to habitat loss and habitat fragmentation. Generally, this group of bird species often requires large areas of unfragmented forest for their successful reproduction.

The largest potential forested habitat patch on the RRTS is directly adjacent and east of the rifle range. The mixed hardwood-oak forest cover type provides a relatively intact habitat patch for these species. This cover type is also maximized by the adjacent scrub-shrub wetland cover type bordering three sides of the forest patch. Additionally, the brackish tidal marsh cover type provides a habitat ecotone or edge effect to the south and east of the mixed hardwood-oak forest cover.

Quarterly avian surveys resulted in the observation of three forest-interior Neotropical migrant bird species. Since the quarterly avian surveys were observational in nature, no species-specific detailed survey was conducted. The Ovenbird (common breeder) was observed along stream number 6 in the scrub shrub wetland east of the rifle range. The Ovenbird male exhibited territorial behavior when observed during the latter part of the spring quarter (late May). No nest was observed but nesting was presumed to occur due to the high quality of the habitat.

The Wood Thrush (common breeder) and the Veery (very rare breeder) were observed in May within the mixed hardwood-oak forest east of the rifle range. No specific behavior was attributed to the Wood Thrush sighting. The Veery is a state species of conservation concern because Delaware is on the periphery of the species range. The presence of the Veery at the installation was most likely a mere transient. No territorial, pair bonding or breeding behavior was observed and no nest structure was found.

In addition to colonial wading birds and forest-interior Neotropical migrant birds, raptor (birds of prey) species were observed. The raptor state species of conservation concern that were not considered a transient or fly over were the Coopers Hawk (extremely rare breeder) and the Red-shouldered Hawk (very rare to uncommon). The Coopers Hawk sighting occurred during the spring within the red maple sweet gum, successional hardwood forest located south of the rifle range berm at the edge of the brackish tidal marsh. However since no specific behavior was attributed to the Coopers Hawk sighting, no breeding inferences can be drawn. The Red-shouldered Hawk was observed singly (October) and in pair (summer) within the mixed hardwood-oak forest and scrub shrub wetland ecotone to the east of the rifle range. No nesting or mating behavior was observed.

The installation should continue with its limited disturbance policies within the habitat cover types discussed for all three of these categories of birds (colonial wading birds, forest-interior Neotropical migrant birds, and raptors). State species of special conservation concern are further discussed in the next section.

Mammals and Herptiles

The mammal and invertebrate species observed were considered typical species found in a developed yet fragmented forested coastal plain and brackish tidal marsh habitat. The reptiles

and amphibian species noted were also very common to the area. However, it should be noted that due to the prevalence of forested wetland and vernal pool type habitats there is a strong likelihood that rare or unique herptile may be found on the installation. A historical discussion of this potential can be found in Section 5.4.

Aquatic Species

A variety of aquatic species were identified at the RRTS during the 2005 surveys. The brackish water tidal creeks on and adjacent to the property provide habitat for killifish species and were observed during the vegetation surveys. The fiddler crab (Uca spp.) and various snail species were observed during the vegetation surveys. Typical salt marsh invertebrate community species may include mud snail (*Illyanassa obsoleta*), saltmarsh snail (*Melampus bidentatus*), ribbed mussel (*Geukensia demissa*), and grass shrimp (Palaemonetes spp.) (Kreamer, 1995).

THREATENED AND ENDANGERED SPECIES PLS

Regulations

The Endangered Species Act (ESA) of 1973 (as amended 1982 and 1987), is intended to prevent the further decline of federally-listed endangered and threatened plants and wildlife and to help restore populations of these species and their habitats. The ESA, jointly administered by the Department of Commerce and the Department of the Interior, requires that each federal agency consult with the US Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) to determine whether endangered or threatened species are known to exist, or have critical habitats, at or in the vicinity of the site of a proposed action. To date, no federally listed species have been documented at the RRTS.

The Department of Army and DEARNG must comply with several aspects of the ESA. The ESA requirements imposed on the Department and DEARNG are presented in detail in AR 200-3 and are summarized below:

- To carry out programs for the conservation of listed species.
- To ensure that any actions taken do not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat.
- To formally consult and confer with USFWS and NMFS to determine if any action may affect, beneficially or adversely, a listed species or critical habitat. Formal consultation is only necessary if an action is determined by the DEARNG and USFWS and/or NMFS to adversely affect a listed species or critical habitat.
- To not "take" listed fish and wildlife species, or remove and/or destroy listed plants. Take, as defined by the ESA, means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Habitat modification can be considered a take if death or injury of wildlife occurs from removing essential habitat components or impairing essential behavior patterns, such as breeding feeding, or sheltering.

The state of Delaware regulates activities related to the importation, transportation, possession, or sale of any endangered species of fish or wildlife (7 Del. C. 1953, § 601; 58 Del. Laws, c. 65.). The DNREC Division of Fish and Wildlife administers permits and licenses for such activities.

Threatened and Endangered Species at the RRTS

No state- or federally-listed threatened or endangered species have been identified at the RRTS. However several bird species of special concern in the state were observed on or flying over the property, and spotted turtles were previously observed in temporary pools at the north end of the site and may breed on site (WRA, Inc., 1995b). The installation is currently not aggressively using the forested and wetland cover types were the majority of the species of concern were observed. The table below identifies rare species present at the NCRR with a Delaware Natural Heritage Inventory (NHI) ranking of S1, S2, or S3 (see table notes for reference).

Rare, Threatened, and Endangered Wildlife Observed at the RRTS in 2005

			Ecological Community									
Scientific Name	**Common Name**	**NHI Status [(1)]**	**Flyover**	**Disturbed forest edge**	**Mixed Hardwood-Oak Forest**	**Mixed Successional Forest (formerly Shrubland)**	**Successional Grassland (Includes reforested area)**	**Red Maple/Sweet Gum Successional hardwood forest**	**Red Maple/Sweet Gum Swamp**	**Scrub/Shrub Wetland**	**Brackish Tidal Marsh (formerly phragmites BTM)**	**Brackish Tidal Low Marsh Points (formerly Spartina brackish tidal marsh)**
Accipiter cooperii	Coopers Hawk	S1B, SZN						**x**				
Ardea albus	Great Egret	S1B	**x**								**x**	
Ardea herodias	Great Blue Heron	S2B	**x**								**x**	
Buteo lineatus	Red-shouldered Hawk	S2B/S3N	**x**		**x**					**x**		
Catharus fuscescens	Veery[(2)]	S2B			**x**							
Certhia americana	Brown Creeper	S1B, S4N			**x**							
Haliaeetus leucocephalus	American Bald Eagle	S2B, S3N	**x**									
Hylocichla mustelina	Wood Thrush[(2)]	S5B			**x**							
Melospiza georgiana	Swamp Sparrow	S3B, S4N								**x**	**x**	
Phalacrocorax auritus	Double-crested Cormorant	S1B, SZN	**x**									
Picoides villosus	Hairy Woodpecker	S3			**x**							
Plegadis falcinellus	Glossy Ibis	S1B									**x**	
Riparia riparia	Bank Swallow	S2B	**x**							**x**	**x**	
Seiurus aurocapilla	Ovenbird[(2)]	S5B			**x**							
Spizella passerina	Chipping Sparrow	S3N, S5B					**x**			**x**		
Vireo gilvus	Warbling Vireo	S2B						**x**				

Source: Avian observations from October 2004 through July 2005. Natural Heritage Indicator (NHI) Status from Delaware Natural Heritage Program.

(1) NHI Status

S1 = Extremely rare within the state (typically 5 or fewer occurrences) or because some factor immediately threatens the future existence within the state.

S2 = Very rare within the state (typically 6 to 20 known occurrences). Species is susceptible to becoming extirpated.

S3 = Rare to uncommon (typically 21 to 100 known occurrences). S3 species are not immediately threatened with extirpation, but may be if additional populations are destroyed.

The suffix "N" refers to occurrence as a nonbreeder; "B" refers to occurrence during breeding season.

A "Z" qualifier indicates species that regularly migrate through the state, but do not breed or winter in Delaware.

(2) Forest-Interior Neotropical Migrant Bird Species afforded special consideration by the Delaware Natural Heritage Program

Species Descriptions

Accipiter cooperii - (Bonaparte, 1828)
Cooper's Hawk

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Falconiformes	Accipitridae	Accipiter

Genus Size: D - Medium to large genus (21+ species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Accipiter cooperii
Taxonomic Comments: Constitutes a superspecies with A. GUNDLACHI and A. BICOLOR (AOU 1998). See Whaley and White (1994) for information on geographic variation.

Short General Description: A crow-sized, woodland hawk.

General Description: A medium-size diurnal raptor with rounded wings, a long brown/black banded tail (often rounded at the end), and a hooked bill; adult is mainly gray/brown above, barred rusty brown below, with strong contrast between dark crown and paler nape and back; immature is paler, with brown upperparts, dark-streaked whitish or buffy underparts, and white undertail coverts. Average length 36-51 centimeters, wingspan 74-94 centimeters; females average larger than males (NGS 1983).

Diagnostic Characteristics: Differs from sharp-shinned hawk (ACCIPITER STRIATUS) by longer, more rounded tail that has a wider white terminal band; larger head; and (in adult) stronger contrast between the dark crown and paler nape and back. Differs from goshawk (ACCIPITER GENTILIS) in smaller size (average length 36-51 centimeters vs. 53-66 centimeters), lack of conspicuous pale eyebrow, less conspicuous white undertail coverts, broader white tip on tail, and proportionately longer tail and shorter wings (NGS 1983).

Reproduction Comments: The breeding season usually begins in early April and extends through May and June (Bent 1937, Brown and Amadon 1968). The annual molt begins in late June but can occur as late as October (Bent 1937). Southward migration commences in the northern states in late August, with September being the peak month; it is essentially over by November. Northward migration occurs from late February to early April (Brown and Amadon 1968).

The male does most of the nest building and occasionally some of the incubation; most of the incubation is done by the female, which seldom leaves the nest before the young have fledged (Brown and Amadon 1968). During the pre-fledging period the male provides both the female and the young with food, while both parents feed the young for up to four weeks after they leave the nest (Brown and Amadon 1968).

Only one brood is raised each year. The normal clutch is four-five eggs, with clutches of three and six being rarely observed (Bent 1937). A national average has been calculated at 3.5 eggs (Bednarz et al. 1990). Replacement clutches are laid if the first set is lost, and laying can be delayed under conditions of low food availability (Bent 1937, Snyder and Wiley 1976).

Hatching success data are limited, but in areas unaffected by DDT contamination the average hatching rate ranges from about 70% to 83% (Craighead and Craighead 1956, Johnsgard 1990), with some further reduction in the brood occurring after hatching. Normal fledging success rates range from 2.1 to 3.5 for pairs with successful nests (Craighead and Craighead 1956, Schriver 1969, Henny and Wight 1972, Reynolds and Wight 1978, Herron et al. 1985); roughly 80% of nests produce at least one fledgling (Henny and Wight 1972). In areas affected by DDT poisoning these figures were reported to be dramatically reduced.

The young fledge one month after hatching, the males leaving the nest three-four days earlier than the larger females. They remain dependent on their parents until they are eight weeks of age and have learned to forage on their own (Brown and Amadon 1968). Only about 19% of the birds breed in their first year. Most nest by the second year and continue breeding throughout the rest of their lives.

Ecology Comments

Few data on population densities exist. Craighead and Craighead (1956) found 1554 hectares per pair in 1947-1948 in Michigan. In Maryland a density estimate of 200 hectares per pair was calculated by Stewart and Robbins (1958). Rosenfield et al. (1991) compiled nesting densities from various studies. These densities ranged from a low of 5000 hectares per pair in North Dakota in 1987, to a high of 331 hectares per pair in a pine plantation in southeastern Wisconsin in 1986.

Strongly territorial. Males vigorously defend an area 30 meters in diameter around the nest site although they may forage up to 3.2 kilometers away (Brown and Amadon 1968). Johnsgard (1990) reported home range sizes that ranged from 105 to 784 hectares (the latter was seasonal home range; daily home range was 231 hectares). Nests are typically spaced 2.4 - 5.6 kilometers apart (Brown and Amadon 1968,

Reynolds and Wight 1978, Kennedy 1980, Campbell et al 1990) and not usually less than one kilometer apart (Palmer 1988). The smaller sharp-shinned hawk also appears to keep similar distances from Cooper's hawk nests (Brown and Amadon 1968, Reynolds and Wight 1978), indicating interspecific aggression probably related to competition for food. Winter range is larger. Michigan birds ranged over areas of 2.4 - 3.2 kilometers in diameter.

Dispersal range is limited. In Wisconsin, six males dispersed 4 - 35 kilometers (mean 12 kilometers) from natal site to nesting site; one female dispersed 14 kilometers (Rosenfield and Bielefeldt 1992). Hunt by a combination of still-hunting and searching flights along woodland edges and natural routes (Johnsgard 1990).

Birds following inland migration routes apparently migrate over longer distances than those following coastal routes, and tend to have longer wings and tails, creating lower "flight-surface loading." This is thought to be an adaptation to the longer flight distances, more open country, and stronger thermal updrafts encountered along the inland routes (Smith et al. 1990).

Mortality appears to be quite high during the birds' first winter, approaching 78% as opposed to only 34% per year for the adults 2 to 8 years old (Henny and Wight 1972). The maximum recorded lifespan is 8 years (Henny and Wight 1972). Life history traits place it intermediate for population turnover rate between the larger goshawk and smaller sharp-shinned hawk. This may partially explain the slower recovery of Cooper's from a population crash in the 1950s-1960s compared to sharp-shinned hawks (Bednarz et al. 1990).
Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: Northernmost populations migratory (move north mostly March-April, southward late August-early November) but regularly present throughout most of breeding range in winter. Migrates singly or in twos or threes (National Geographic Society 1983). See Palmer (1988) for more information.

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Forest - Conifer, Forest - Hardwood, Forest - Mixed, Suburban/orchard, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed
Habitat Comments: BREEDING: Primarily mature forest, either broadleaf or coniferous, mostly the former; also open woodland and forest edge (AOU 1983). Nests in both pine and hardwood groves, and riparian cottonwoods and sycamores in the West; Douglas-fir in northeastern Oregon. Usually builds new nest on horizontal limb near trunk or in crotch, 6-18 meters above ground; may modify old one or squirrel or crow nest. Campbell et al. (1990) reported one instance of a nest being reused for six consecutive years in British Columbia. Rosenfield and Bielefeldt (1992) found that nesting areas were irregularly reused by the same or different adults in subsequent years.

Generally is an inhabitant of deep woods, utilizing thick cover both for nesting and hunting. Openings, especially where hedgerows or windbreaks offer shelter for prey species, may also be used when foraging. Johnsgard (1990) states that Cooper's are less fussy about the forest type than sharp-shins, and are more often "associated with deciduous and mixed forests and open woodland habitats such as woodlots, riparian

woodlands, semiarid woodlands of the southwest, and other areas where the woodlands tend to occur in patches and groves or as spaced trees."

In the Northwest and Northeast, conifers are used for nesting (Bent 1937, Reynolds et al. 1982), but elsewhere the preference is for hardwoods (Brown and Amadon 1968). In the Northwest a preference may exist also for the cooler microclimates offered by north and east facing slopes (Reynolds et al. 1982). In that area, the Cooper's hawk is typically found in middle-aged stands, 50 - 60 years in age, whereas the sharp-shin prefers younger stands and the goshawk older ones (Reynolds et al. 1982). That difference might express competitive displacement, because in the East, where the goshawk rarely nests, the Cooper's hawk prefers mature stands (Brown and Amadon 1968).

In some areas the species seems to require large tracts of forests and to avoid human contact, in others they may use small forest tracts, (e.g., British Columbia and Nevada), woodlots (e.g., Ohio) or urban/suburban areas where they seem tolerant of human activities (e.g., British Columbia, Utah, Wisconsin, Indiana) (Hennessy 1978, Herron et al. 1985, Campbell et al 1990, Peterjohn and Rice 1991, Rosenfield et al. 1991).

In New Jersey-New York, nested mostly in mixed deciduous-coniferous forest with eastern hemlock the dominant coniferous species at many sites. Tended to nest in areas with relatively large basal area and more canopy cover. Nests located in live overstory trees (43% conifers), typically within the canopy, and always in dense forest but commonly near wetland openings or source of water, on level ground or lower slopes, typically several hundred meters from paved roads (but sometimes within 100 meters or less). Avoided southern exposures (Reynolds et al. 1982, Bosakowski et al. 1992).

A recent study in Missouri documented numerous Cooper's Hawks nesting in young pine plantations in essentially the same habitat as sharp-shins. Also found that trees with deformed crowns were preferred (Wiggers and Kritz 1991). Rosenfield et al. (1991) report that pine plantations are important habitat for breeding Cooper's hawks throughout the Midwest, and particularly in Wisconsin. See Kennedy (1988) for details on nesting habitat in New Mexico.

NON-BREEDING: Migrates mostly along ridges and coastlines (NGS 1983). Winter habitat is much the same as in the nesting season, although open woodlands and fields may be utilized to a greater extent.

Adult Food Habits: Carnivore

Immature Food Habits: Carnivore

Food Comments: Eats medium-sized birds (e.g., starling, thrush, quail), sometimes small birds and some up to size of adult ruffed grouse, small ground-foraging mammals, occasionally reptiles (especially in southwestern U.S.) and amphibians. Their primary food is other birds; up to 90% of its diet is composed of avian prey, with mid-sized birds such as flickers and starlings being taken preferentially (Kennedy 1980). They are frequently important predators of bobwhites and were at least formerly, before the days of factory farming, raiders of domestic fowl. These food choices have led to a great deal of persecution by humans. Additional foods include small mammals, reptiles, amphibians, and insects (Bent 1937). In the southwest and west mammals and lizards can make up as much as half the food intake (Johnsgard 1990). Young birds comprise a large proportion of the food provided to nestlings. Typically hunts from

inconspicuous perch, or uses a longer searching flight. Sometimes attracted to birds at feeders. Birds may not necessarily prevail in the diet (Bielefeldt et al. 1992).

Adult Phenology: Diurnal
Immature Phenology: Diurnal
Length: 51 centimeters
Weight: 529 grams

Global Status: G5
Global Status Last Reviewed: 26Nov1996
Global Status Last Changed: 26Nov1996
Rounded Global Status: G5
Reasons: Large breeding range throughout the forested portions of the contiguous U.S., southern Canada, and northern Mexico; populations have stabilized or are increasing in some parts of range, but the species has not fully recovered from the drastic decline of the period 1940-1970+ throughout much of the eastern part of the range; reasons for this lack of recovery are unknown; potentially threatened by the use of organochlorine biocides in Central America and locally by habitat loss.

National Status: N5B,N5N
State Status: Delaware (S1B)

Stewardship Overview: Populations declined drastically in the eastern half of the continent between the 1940s and the early 1970s. After the ban of DDT in the U.S., populations began to rebound in some areas, but apparently still remain much below pre-DDT era levels throughout much of the region. The population recovered susbstantially in some areas (e.g., Ohio, Wisconsin). The lack of rebound in many areas has led to speculation that DDT is still picked up by migratory birds that winter in Central and South America and compose the major part of the diet. Little data to substantiate this claim exist. Few analyses of reproductive success or of DDT residues in eggs have been conducted, but results do not point to an obvious contaminant problem.

While many suggest that the main solution to recovery appears to be an international ban on the use of DDT and related pesticides, controlling habitat destruction is cited in other references. Research into the reproductive success rates, pesticide residues, prey population levels, habitat characteristics, and competitor populations are needed before a real understanding of how to protect this species is possible. In the meantime, standardized effective survey methods, such as censuses employing taped conspecific calls should be used systematically throughout the species' range to establish population levels and fluctuations. Whenever possible, known nesting sites should be protected from human disturbance and the public should be educated concerning the value predatory species have in maintaining a balance in natural ecosystems.
Restoration Potential: Given the continued low population levels since the banning of DDT in the United States, the major solution to recovery may require an international end to the use of DDT and related organochlorine pesticides, particularly in Central and South America. If that can be accomplished, this species should be able to return to its former numbers, at least in areas that are still forested. However, it may be that other presently unknown factors are also involved in keeping numbers low.

Preserve Selection & Design Considerations: Although habitat requirements of this species are apparently

highly variable and not well-defined, the following conservative guidelines are offered. Blocks of woodlands of a minimum of several hundred hectares (based on measured home range size of 100+ to 700+ hectares) are needed by this species for successful reproduction and foraging; forest tracts of six to eight hectares should be left unthinned around the nests to provide sufficient cover at the nest site (Reynolds et al. 1982, Rosenfield et al. 1991). In addition to protecting known nesting territories, attention also needs to be given to providing additional space into which the population can expand. The degree to which a site can be protected from human intrusion and raccoon predation should also be considered. Management Requirements: Generally thought to need large tracts of relatively mature forests, particularly during the nesting season. This suggests management options that minimize forest fragmentation. The value or impact of forest edge habitat to this species, however, needs to be defined before management prescriptions can be made. Cooper's hawks reportedly forage in both wooded and open areas (Kingsley and Nicholls 1991). Where riverine forest corridors are used, management to maintain these corridors free of roadways, mining and other long-term disruption is needed (Herron et al. 1985). Additional protection from human disturbance would presumably raise the fledging success rate, since this species usually avoids populated areas when nesting (Snyder 1978). In areas with high raccoon populations, reduction of raccoon access to nests may be needed. Raccoon guards placed on nest trees and precautions taken during nesting studies can greatly decrease raccoon predation (Shriver 1969, Fyfe and Olendorff 1976).

In general, tree cutting in the vicinity of nests should be avoided and known nest sites should be protected from human disturbance during nesting season. A buffer zone of eight-ten hectares with no tree harvest has been recommended (Crocker-Bedford 1990). When managing for the benefit of Cooper's hawks, the practice of thinning stands for commercial or non-commercial purposes should be avoided in order to maintain the preferred density of cover (Reynolds et al. 1982). In the southwestern U.S., Reynolds et al. (1982) recommended the following actions to produce and maintain desired forest conditions: thinning trees in the understory, creating small openings in the forest, and prescribed burning; also deemed important were the provision of abundant snags and large downed logs, woody debris, interspersion of different tree sizes across the landscape, and ample older-aged forest. See Crocker-Bedford and Chaney (1988) for recommendations on management of nesting habitat in northern Arizona, Thomas et al. (1993) for a brief summary of protection and management needs in the Pacific Northwest, and Lefranc and Glinski (1988) for research needs and management recommendations for the southwestern U.S. Monitoring Requirements: Status and methods of effective management cannot be determined until more is known about basic biology, abundance, and distribution (Rosenfield et al. 1991). Surveys of nesting birds using standardized effective techniques are needed across the range so that status of breeding populations can be assessed on a regional basis. These surveys will need to be repeated at least biannually for a number of years before patterns of population fluctuations and trends can be distinguished.

During the nestling stage, broadcast recordings of vocalizations (conspecific and great horned owl) can markedly increase the chance of detections near nests (Rosenfield et al. 1985; see also Fuller and Mosher 1987). Point count transects with broadcasts of recorded calls have been found to be more effective than either walking, driving continuously, or looking and listening only at roadside stops (Mosher et al. 1990). Mosher et al. (1990) suggested 10-15 minute stops for these transects.

After the young fledge, the observation of parental feeding also constitutes good evidence of their nesting within the vicinity. Since pairs show strong site-fidelity to a nesting area over several years, return visits in subsequent breeding periods should be made to reaffirm their presence. Iverson and Fuller (1991)

describe an index of relative abundance, "area occupied," that can be used to compare relative abundance and distribution, rather than absolute density. This index, adjusted by a correction factor, the "probability of detection," allows changes in population over time, or differences among habitats to be compared.

Additional clues to presence within an area are provided by their repeated use of certain stumps or low perches for plucking their prey; the remains of birds the size of flickers (COLAPTES spp.) or larger should help to distinguish these sites from those of sharp-shins. Once presence is known or suspected, the nest site should be located by looking for droppings or feathers lying on the ground below it.

To track overall trends, migration counts on all major census routes should be continued. Studies of wintering populations employing radio-tracking would also help to decipher the population status and trends. Studies monitoring reproductive success, prey availability, weather, and other possible causal variables should be conducted in conjunction with the population monitoring to provide understanding of the meaning of fluctuations and trends.
Management Research Needs: Mosher et al. (1990) criticizes general bird survey methods, short term trend analysis, and local research projects as inadequate for assessing population status and trends for woodland raptors. He suggests that standardized survey methods and range-wide efforts to define the normal range of reproductive performance, population density, and the factors that affect these parameters are needed. He lists the following research needs: effect of forest maturation on raptor species abundance and composition; impacts of forest management and agricultural practices on raptors; tree age and species composition trends in eastern forests and how and where these trends will likely impact woodland raptors; mechanisms controlling year-to-year fluctuations in reproductive parameters; relationship of reproductive parameters to prey density; and relationship of annual reproductive rate to fall migration counts, if possible. California and Northeastern states should be high priorities for research because of suspected declines or poor population recovery.

Studies determining fledging success are needed along with bioassays for organochlorine residues in eggs and adults. Monitoring levels of organochlorines in adults can be accomplished by assaying blood plasma, which has been shown to correlate quite well with levels in eggs, and hence with egg-shell thinning (Henny and Meeker 1981). Examination of dead hawks for organophosphate pesticide poisoning is needed in light of a few recent reports of Cooper's hawk poisonings (Rosenfield et al. 1991).

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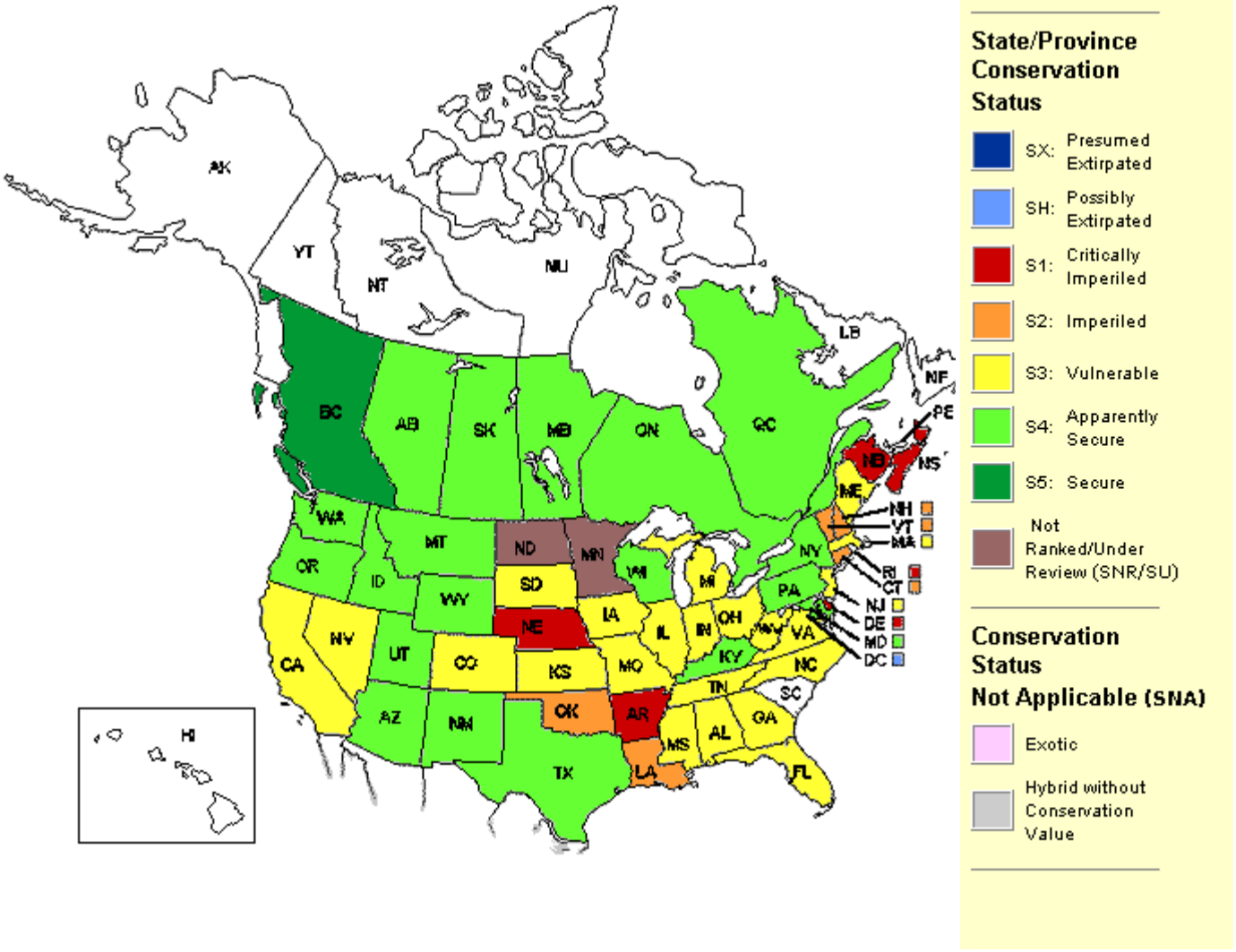
http://www.natureserve.org/infonatura/servlet/InfoNatura?sourceTemplate=Ltabular_report.wmt&loadTemplate=Ldetail_report.wmt&selectedReport=&summaryView=Ltabular_report.wmt&elKey=100417&paging=home&save=true&startIndex=1&nextStartIndex=1&reset=false&offPageSelectedElKey=100417&offPageSelectedElType=species&offPageYesNo=true&selectedIndexes=100417


State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
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Exotic
Hybrid without Conservation Value
AK
YT
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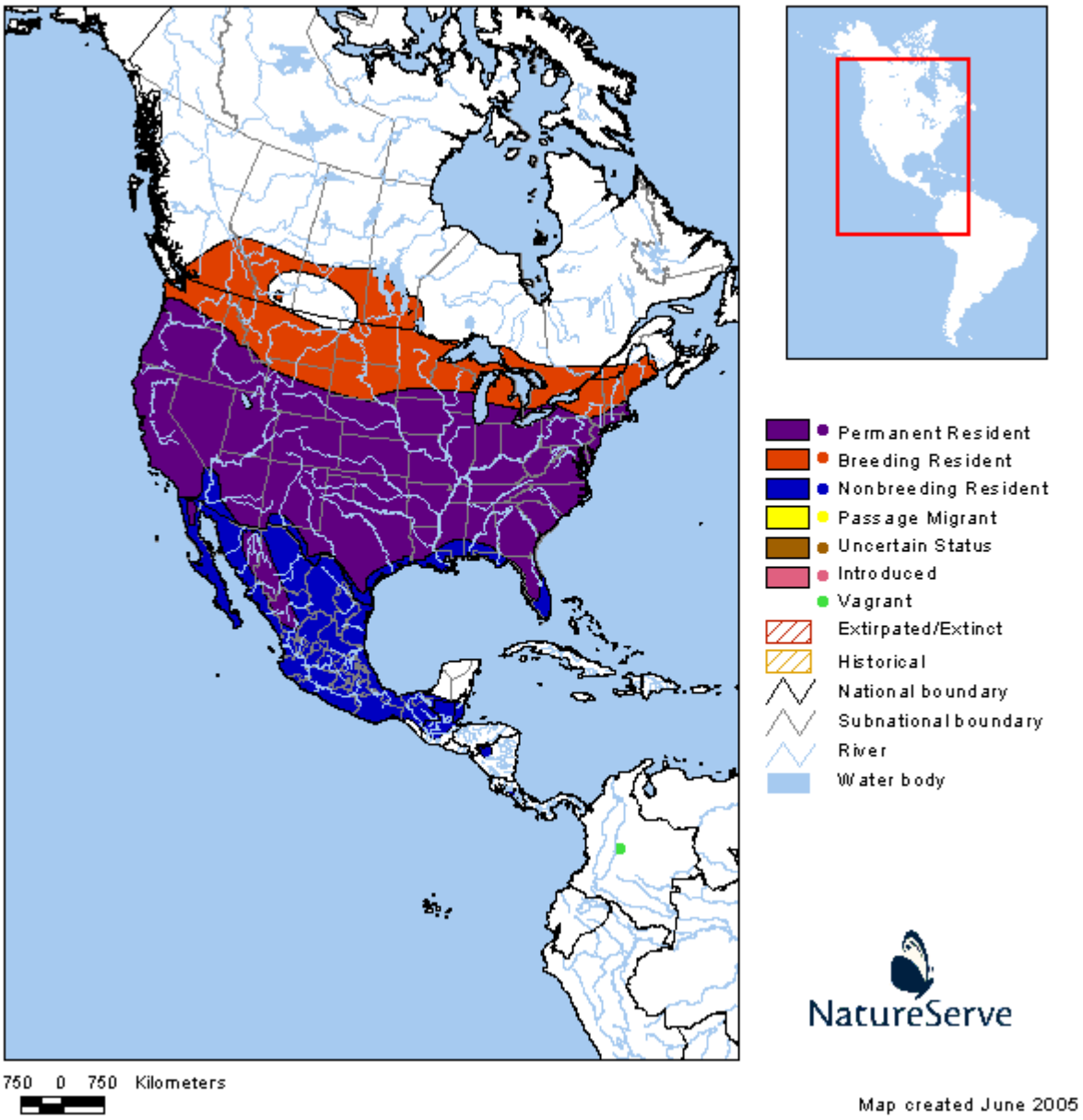
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Ardea alba - Linnaeus, 1758
Great Egret
Other Related Names: Casmerodius albus (Linnaeus, 1758)

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Ciconiiformes	Ardeidae	Ardea

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Ardea alba
Taxonomic Comments: Formerly included in the genus CASMERODIUS (see AOU 1995). Has been included in genus EGRETTA by some authors (AOU 1998).

General Description: A large wading bird with all-white plumage; long black legs and feet; a long neck; and a long, straight, pointed, yellow bill; in breeding plumage, long white plumes extend from back beyond end of tail; average length 99 cm, wingspan 130 cm (NGS 1983).

Diagnostic Characteristics: Differs from most other white herons in larger size (averages 23 cm longer than reddish egret, 38 cm longer than snowy egret), unicolored yellowish bill, and all-black legs and feet. Differs from the white form of the great blue heron in having black legs and feet (vs. yellowish).

Reproduction Comments: Clutch size is 1-6 (usually 3-4) in the north, 2-3 in the south. Incubation lasts 23-25 days, by both sexes. Young fly at about 6 weeks. Nests solitarily or in small to large colonies (Harrison 1979). In Florida, failure of nests was associated with high rainfall (Frederick and Collopy 1989). May lay another clutch if eggs are lost during incubation (Byrd and Johnston 1991).
Ecology Comments
Nonbreeding: may gather in groups but usually forages singly, spreading out over available area.

In Florida, nestlings infected by the nematode EUSTRONGYLIDES IGNOTUS experienced higher mortality rates than did uninfected nestlings (Spalding et al. 1994).
Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: Migratory in north; extensive post-breeding dispersal occurs prior to southward migration (Palmer 1962). Some banded in the U.S. reach northern Colombia (recorded in September and November; Hilty and Brown 1986). Breeders from the U.S. Atlantic coast are thought to winter in the Bahamas and West Indies (see Byrd and Johnston 1991). Migrants from the north are present in Costa Rica October-April (Stiles and Skutch 1989).

Estuarine Habitat(s): Bay/sound, Herbaceous wetland, Lagoon, River mouth/tidal river, Scrub-shrub wetland, Tidal flat/shore

Riverine Habitat(s): Low gradient

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): FORESTED WETLAND, HERBACEOUS WETLAND, Riparian, SCRUB-SHRUB WETLAND

Terrestrial Habitat(s): Grassland/herbaceous

Habitat Comments: Marshes, swampy woods, tidal estuaries, lagoons, mangroves, streams, lakes, and ponds; also fields and meadows.

Nests primarily in tall trees, usually with other colonial water birds; in woods or thickets near water. See Spendelow and Patton (1988) for further details and information on geographic variation in nesting habitat. Returns to the same colony sites year after year.

Adult Food Habits: Carnivore, Invertivore, Piscivore

Immature Food Habits: Carnivore, Invertivore, Piscivore

Food Comments: Eats mainly fishes, amphibians, snakes, snails, crustaceans, insects, and small mammals; commonly forages in marshes and shallow water of ponds, also in fields (Palmer 1962).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Phenology Comments: Arrives at roost at sunset or at dark, departs at first light (Palmer 1962). Forages during daylight (Powell 1987).

Colonial Breeder: Y
Length: 99 centimeters
Weight: 935 grams

Global Status: G5
Global Status Last Reviewed: 20Nov1996
Global Status Last Changed: 20Nov1996
Rounded Global Status: G5
Reasons: Secure due primarily to the very large range, though the amount of suitable nesting habitat is relatively restricted.

National Status: N5B,N5N
State Status: Delaware (S1B)

Global Abundance: 100,000 to >1,000,000 individuals

Global Abundance Comments: See Spendelow and Patton (1988) for information on distribution and abundance of coastal U.S. breeding populations.

Estimated Number of Element Occurrences: > 300

Global Short Term Trend Comments: Populations in the south-central U.S. may be benefiting from crayfish aquaculture; bird population increases may be related to favorable foraging opportunities afforded by expanding crayfish aquaculture (Fleury and Sherry 1995).

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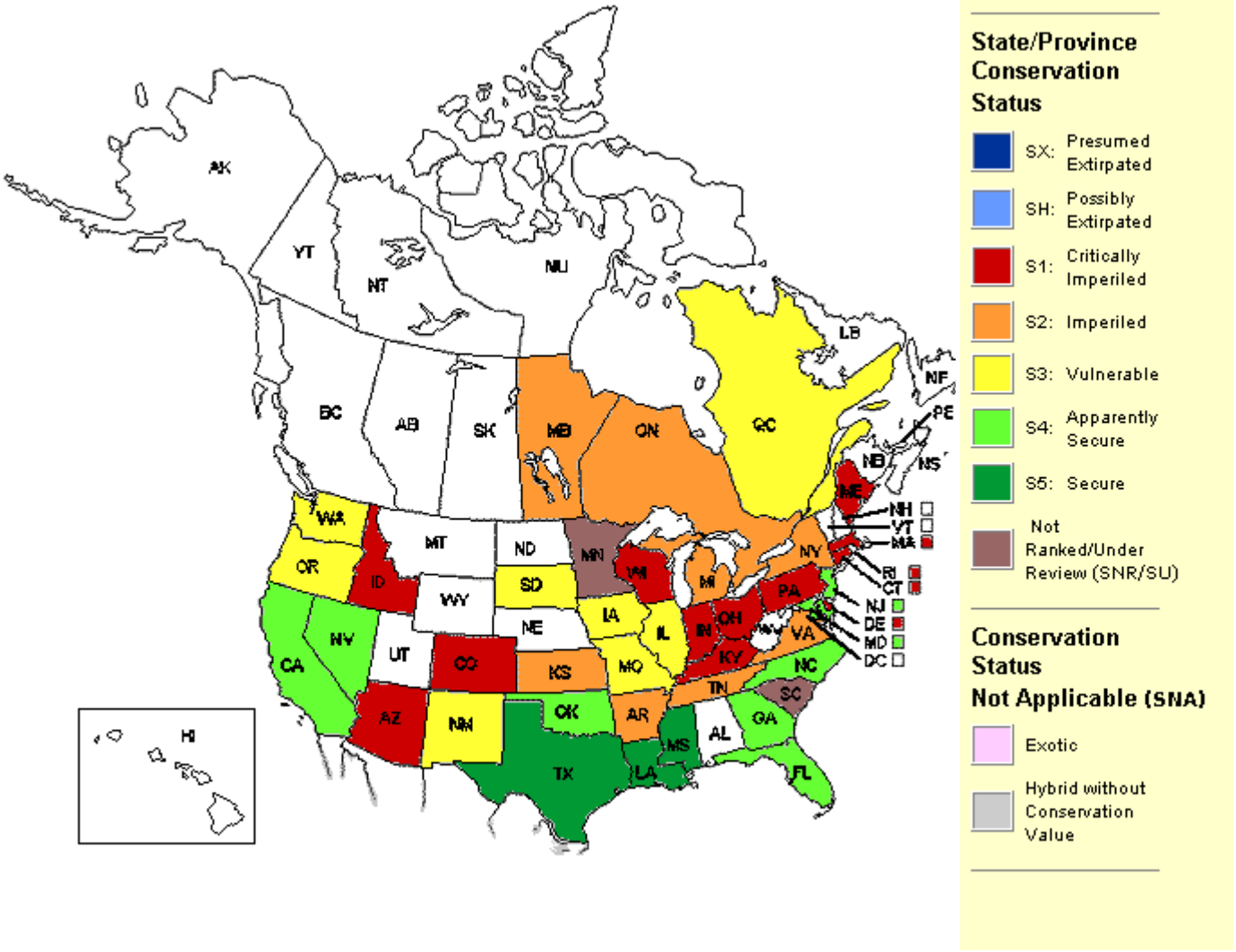
State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
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Hybrid without Conservation Value
AK
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LA
WI
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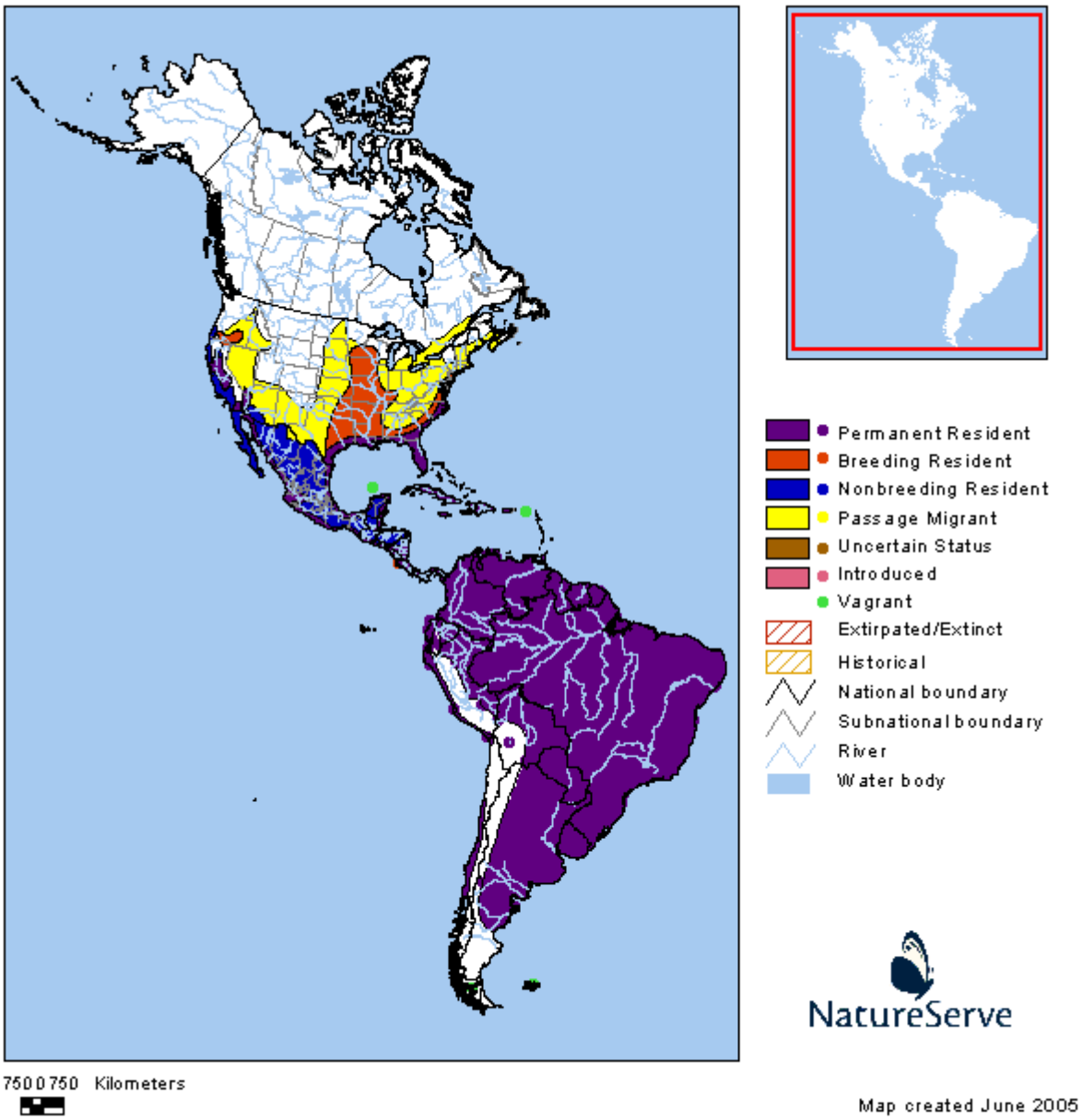
Range Map

Note: Range depicted for New World only. The scale of the maps may cause narrow coastal ranges or ranges on small islands not to appear. Not all vagrant or small disjunct occurrences are depicted. For migratory birds, some individuals occur outside of the passage migrant range depicted. A shapefile of this map is available for download at [www.natureserve.org/getData/animalData.jsp.](www.natureserve.org/getData/animalData.jsp)



Range Map Compilers: NatureServe, 2002; NatureServe, 2004; WILDSPACETM 2002

Ardea herodias - Linnaeus, 1758
Great Blue Heron

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Ciconiiformes	Ardeidae	Ardea

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Ardea herodias
Taxonomic Comments: Includes great white heron, formerly considered a distinct species, A. OCCIDENTALIS. Some authors consider A. HERODIAS, A. CINEREA, and A. COCOI conspecific (AOU 1983); the three constitute a superspecies (Butler 1992).

Short General Description: A wading bird (heron).

Reproduction Comments: Clutch size is 3-7, averages larger in north than in south. Incubation, by both sexes, lasts 25-29 days. Both parents tend young, which leave nest in 60-90 days. May breed at 2 years.

Nests usually in colonies, a few pairs to 100s; sometimes solitary. Fledging success depends importantly on success of parents in providing sufficient food when nestlings are 2-6 weeks old (Bennett et al. 1995, Auk 112:201-209).

Ecology Comments:
Nonbreeding: usually solitary. May establish feeding territories in winter (Stiles and Skutch 1989).
Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y

Mobility and Migration Comments: Migrates to northern breeding range February-early May; departs northerly localities September-October. Disperses in all compass directions after breeding, before southward migration. Southern populations may be quite sedentary. Present in small numbers in Colombia mainly October to mid-April, in Panama mainly September-April (Ridgely and Gwynne 1989, Hilty and Brown 1986).

Estuarine Habitat(s): Bay/sound, Herbaceous wetland, Lagoon, River mouth/tidal river, Scrub-shrub wetland, Tidal flat/shore
Riverine Habitat(s): Low gradient

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): FORESTED WETLAND, HERBACEOUS WETLAND, Riparian, TEMPORARY POOL

Terrestrial Habitat(s): Forest - Conifer, Forest - Hardwood, Forest - Mixed, Grassland/herbaceous, Old field

Habitat Comments: Freshwater and brackish marshes, along lakes, rivers, bays, lagoons, ocean beaches, mangroves, fields, and meadows. Nests commonly high in trees in swamps and forested areas, less commonly in bushes, or on ground, rock ledges, and coastal cliffs. Often nests with other herons. See Spendelow and Patton (1988) for further details and discussion of geographic variation in nesting sites. Generally nests close to foraging habitat.

Adult Food Habits: Carnivore, Invertivore, Piscivore

Immature Food Habits: Carnivore, Invertivore, Piscivore

Food Comments: Eats fishes, insects, crustaceans, amphibians and reptiles, mice and shrews, and other animals. Forages mostly while standing in water but also in fields; sometimes drops from air or perch into water (Palmer 1962, Terres 1980).

Adult Phenology: Circadian, Crepuscular, Diurnal

Immature Phenology: Circadian, Crepuscular, Diurnal

Phenology Comments: Generally tends to be mainly crepuscular but also is active in daytime and at night. In coastal region, activity often is related to the tidal cycle, independent of day-night cycle in some areas (Powell 1987). Nocturnal foraging activity occurs in nontidal situations as well as in tidal environments (McNeil et al. 1993).

Colonial Breeder: Y
Length: 117 centimeters
Weight: 2576 grams

Global Status: G5
Global Status Last Reviewed: 20Nov1996
Global Status Last Changed: 20Nov1996
Rounded Global Status: G5 - Secure

National Status: N5B,N5N
State Status: Delaware (S2B)

Estimated Number of Element Occurrences: > 300
Global Short Term Trend: Stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences)

Global Short Term Trend Comments: Populations generally are stable or increasing in most areas. See Spendelow and Patton (1988) for status of coastal U.S. breeding populations. Populations in the south-central U.S. may be benefiting from crayfish aquaculture; bird population increases may be related to favorable foraging opportunities afforded by expanding crayfish aquaculture (herons may prey on small fishes often abundant in ponds) (Fleury and Sherry 1995).

Threats: In Illinois, a public viewing area used once a week by humans 229 m from a rookery did not cause any overt responses from nesting birds (DeMauro 1993). See Vos (1984) for information on response to human disturbance in Colorado.

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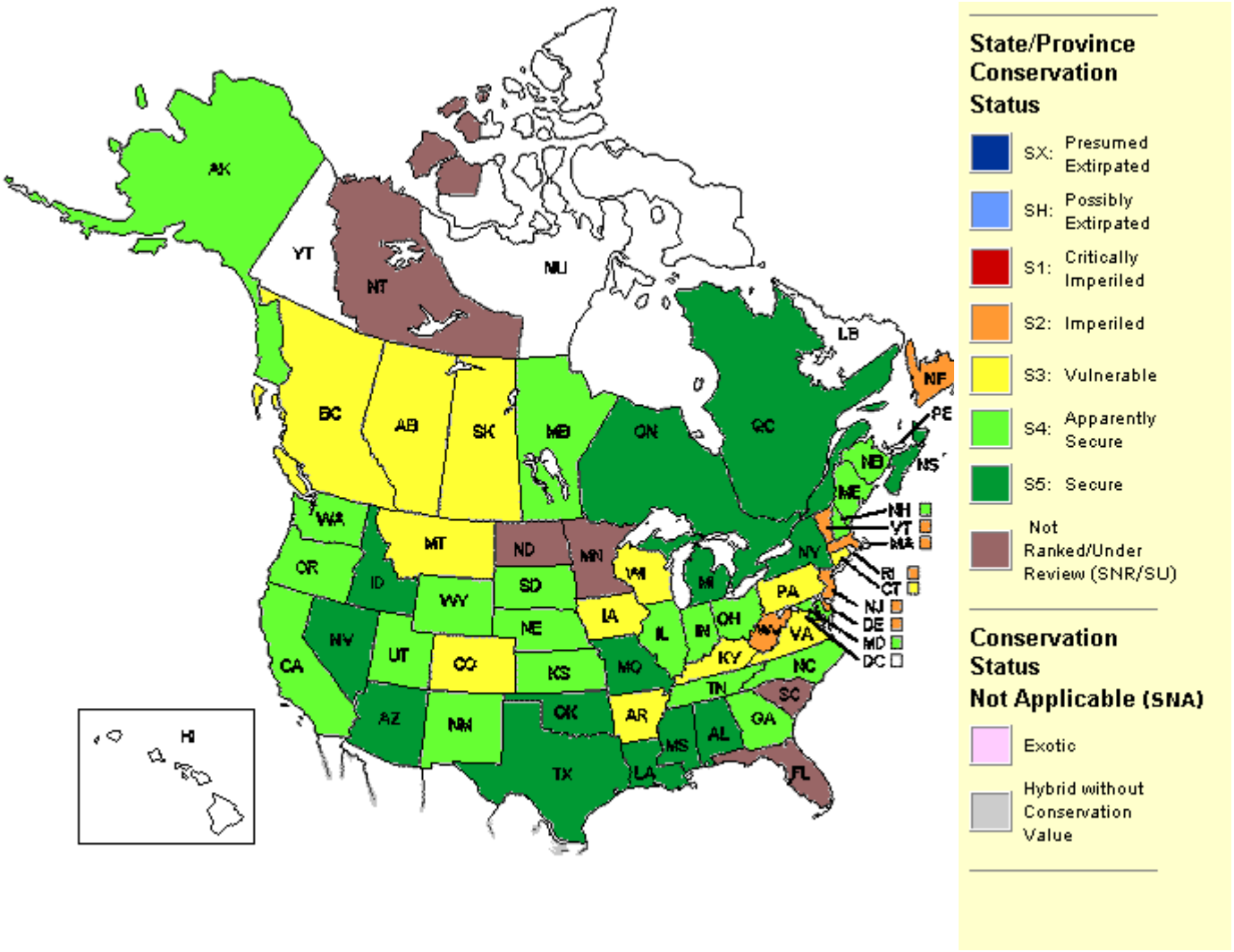
State/Province Conservation Status
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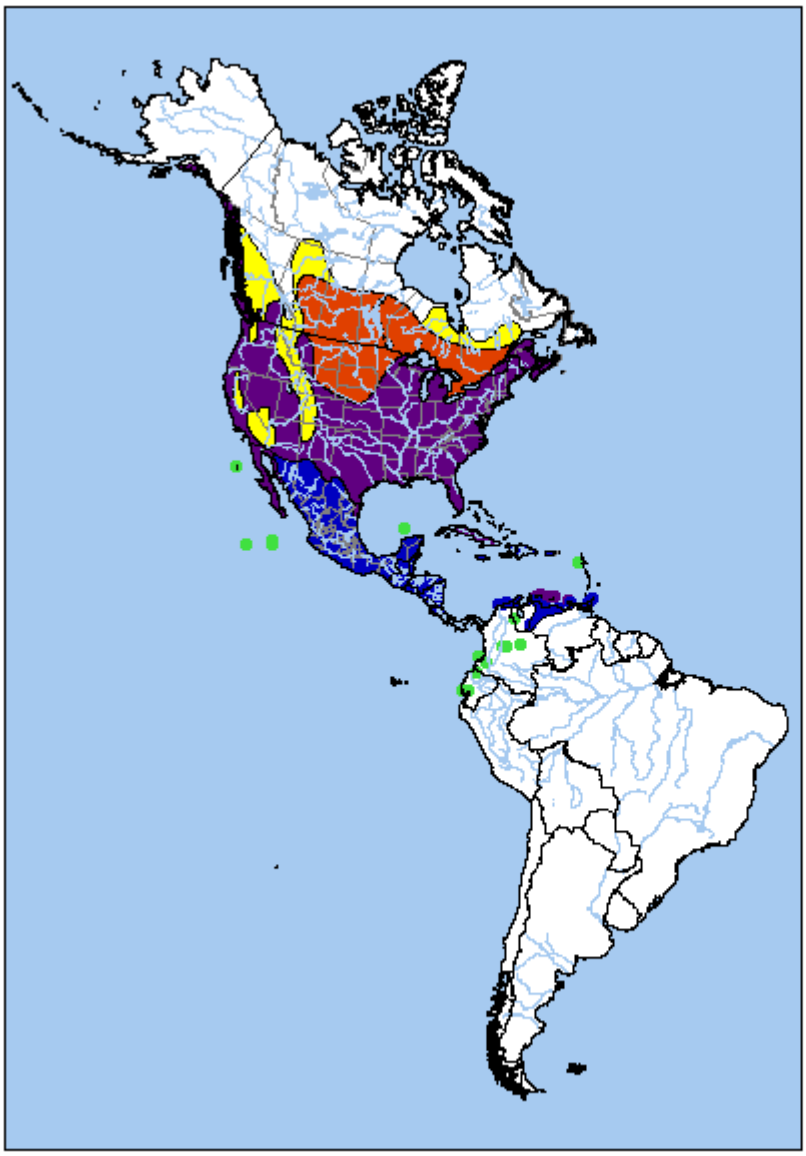


Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body

NatureServe

750 0 750 Kilometers

Map created June 2005

Buteo lineatus - (Gmelin, 1788)
Red-Shouldered Hawk

Photo © 2002 www.arttoday.com

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Falconiformes	Accipitridae	Buteo

Genus Size: D - Medium to large genus (21+ species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Buteo lineatus

Taxonomic Comments: Five subspecies have been recognized. The nominate LINEATUS, formerly

FALCO LINEATUS, is based on the "barred-breasted buzzard" of Latham and the "red-shouldered falcon" of Pennant (AOU 1983). The other four subspecies include ALLENI of the southeastern U.S., EXTIMUS of extreme southern Florida, TEXANUS of Texas and northeastern Mexico, and ELEGANS of the west coast.

Palmer (1988) stated that "the red-shoulder fits better morphologically in ASTURINA than in BUTEO," and placed it in the former as ASTURINA LINEATA. Most authors have retained this species in the genus BUTEO.

The red-shouldered hawk and Ridgway's hawk, B. RIDGWAYI, a resident on Hispaniola and surrounding small islands (Beata, Gonave, Isle-a-Vache, Alto Velo, Grand Cayemite and Petite Cayemite) might constitute a superspecies (AOU 1983).

Short General Description: A large woodland hawk

General Description: ADULTS: A medium-sized, long-tailed, slender buteo, larger than the broad-winged hawk (BUTEO PLATYPTERUS) and smaller than the red-tailed hawk (BUTEO JAMAICENSIS). The long legs and feet are yellow, with less than half the tarsus feathered (versus half in red-tailed hawk). Wingtips do not reach the tail tip on perched birds. Sexes are similar, except that the female is larger, with considerable size overlap. In basic plumage the upperparts are dark but somewhat blotchy. The lesser upper wing coverts are rusty reddish or rufous and form the distinctive red-shoulder patch. The flight feathers are boldly barred with black and white above, not as boldly barred below, with a "window" (a white crescent-shaped panel) near the black outer primary tips. The underwing appears two-toned, with rufous coverts darker than the flight feathers. The wings are proportionately long and narrow, without the bulges of the red-tailed hawk. The leading edge is straight, while the trailing edge curves gently or not at all: "Seen from below, the wing of a red-shouldered hawk suggests a long, rectangular plank. The entire wing juts forward when the bird is in a full soar, as if it were reaching out, arms wide, to embrace something" (Dunne et al. 1988). Soaring typically occurs with wings in a slight downward droop. The underparts have transverse rusty to rufescent barring. The tail has several wide and very dark bars; the intervening narrow stripes and the tip of the tail are white. There is geographical and some sexual variation in the number of these tail bars (Palmer 1988, Clark and Wheeler 1987), among both adults and juveniles. The iris is dark brown and the cere is bright yellow.

YOUNG: nestlings are thickly covered with long, soft, silky down, longest on the head, yellowish-white above, tinged with "vinaceous-buff" on the back and wings, and whiter below. Somewhat older nestlings are covered with short, thick, woolly down, thickest and pure white on the belly, and grayish-white above. At about two weeks the wing quills sprout, followed by the scapulars, wing coverts, and contour plumage (Bent 1937, Kennard 1894).

Juvenile plumage is well-developed by fledging and held through the first winter into spring when gradually molted. It may not be completely molted until the following fall. The head is medium brown, usually with buffy superciliary line and dark brown malar stripes. The iris is light to medium gray-brown and the cere is greenish-yellow. The back is dark brown with some tawny mottling. The upper wing coverts are dark brown with some tawny and whitish mottling and often a hint of the red shoulder. Primaries are dark brown with a crescent-shaped tawny area on the upper surface next to the black tips. The white underparts are marked longitudinally with dark brown blobs. The underwing is uniform white

to cream and shows the distinctive crescent panel or "window" when backlit. Leg feathers and undertail coverts are white and spotted with dark brown. The tail is brown above with many fine lighter brown bands.

A few albinistic and partially albinistic birds have been recorded (Clark and Wheeler 1987).

EGGS: smooth and slightly glossy. Ground color dull white or with a faint buff wash, overlaid with variable blotches, spots, or specks of reddish-brown or dark brown, and rarely pale lilac, with the larger markings concentrated toward the larger end.

VOCALIZATIONS: common during the breeding season (Bent 1937). The most common call is a "kee-aah," with the accent on first syllable, and second extended and with falling inflection (Palmer 1988). Another vocalization includes a single or repeated "kip," which the male gives when fetching prey and nearing the nest, and the female responds similarly, while nestlings have a chirping call. The blue jay (CYANOCITTA CRISTATA) is notorious for mimicking the cry of the red-shouldered hawk. Bent (1937) and Palmer (1988) noted a variety of other vocalizations attributed to this hawk, mostly variants of the kee-aah cry or the nest call.

Reproduction Comments: Courtship, territory establishment, and nest building (or refurbishing) occur shortly after arrival on the breeding grounds. In New York, Crocoll and Parker (1989) recorded birds back on territories and relining nests during the second and third weeks of March. Portnoy and Dodge (1979) in Massachusetts observed courtship flights during March and nest relining during the last week of March and first week of April. Morris et al. (1982) in southwestern Quebec observed territorial hawks soaring from early March to mid-April. Farther south, nesting activities begin several weeks earlier. Records from Alabama, Louisiana, and Oklahoma indicate that breeding begins in February.

Aerial nuptial displays are impressive and include "high-circling" and "sky-dancing," both extremely vocal performances. In the sky-dance, one individual (presumably the male) rides an upward thermal, crying as it circles, then drops with folded wings into a steep dive, pulling up and then shooting upward again. Neighboring pairs often join in, with as many as ten birds involved. The sky-dance can be immediately followed by copulation, which "occurs repeatedly and over considerable time" (Palmer 1988).

Clutch size varies from one to six (Palmer 1988), with two to four eggs being the most common sizes throughout the range. Clutch size is commonly two in Florida, three to four in the northern U.S. A mean of 3.45 eggs from 42 clutches was reported for the Great Lakes States (Henny 1972). Eggs are laid January-June (mostly March-April) in the southeastern U.S., March-June (mostly April) in northern U.S., mostly March-April in California (Palmer 1988). Nests late March to late May in Maryland (Bushman and Therres 1988) and New York (Bull 1974).

Incubation is by both sexes, but mainly by the female, who is fed by the male, and commences with the laying of the first egg. The incubation period is around 33 days per egg (Newton 1979), and the young hatch asynchronously and thus vary in size, as with many raptors (Newton 1979). The semi-altricial young are inactive at first, becoming active at about 10 days. Feathering begins in about two weeks. The nestling period lasts from five to six weeks (Harrison 1978, Crocoll and Parker 1989). Young leave the nest at 5-6 weeks; in California, first flight occurs at about 45 days (sometimes at considerably older age).

Fledging generally occurs in mid-June in Maryland (Janik and Mosher 1982), June to mid-July in New York (Bull 1974, Crocoll and Parker 1989), and late June-early July in Massachusetts (Portnoy and Dodge 1979). Dates are similar throughout the northern range of the species, and are advanced 4 to 8 weeks in the south. In southern California, parents supplied food to young for 8-10 weeks after fledging.

Although a few nest at one year of age (Apanius 1977), most first breed when at least two years old (Palmer 1988). There has been evidence of polyandry with copulation and trio bonding at the nest recorded (Palmer 1988).

Nesting success (measured as the percentage of nests that fledge at least one young) has been reported to vary from 52.9% in Maryland to 100% in Missouri with an average of 68.7% over nine North American studies (Crocoll and Parker 1989). Two one-year studies reported lower nest success rates: 47.4% for 19 nests in northern Lower Michigan in 1986 (Ebbers 1986), and 25% for 1966 at the Patuxent Wildlife Research Center, Maryland (Henny et al. 1973).

The average number of young fledged per nest over the previously cited nine studies varied from 1.11 young to 2.9. Henny et al. (1973) used a mathematical model and field data to predict that in a stable population each pair should fledge an average of 1.95 young. Four of the nine above mentioned studies had fledging numbers below the Henny et al. (1973) standard. Three of the studies were conducted in the Northeast: New York (1.11 young fledged, Crocoll and Parker 1989), Western Maryland (1.8 young fledged, Janik and Mosher 1982), and central Maryland (1.58 young fledged, Henny et al. 1973). One Michigan population produced a mean 1.2 young fledged (n = 44) over three years of study, while another population fledged 2.2 young (n = 29) over the same time period (Ebbers 1989). Ebbers (1989) noted that there is concern that the 1.95 standard may be too high because of possible biases in the data used to scale the model values. Nevertheless, it does appear that some populations produce excess young ("source" populations), while others would not survive without immigration ("sink" populations).

Ecology Comments:
Mortality has been reported to occur during the incubation, nestling, and fledgling stages of the breeding season (Craighead and Craighead 1956, Janik and Mosher 1982, Bosakowski and Speiser 1986, Crocoll and Parker 1989). Adults and juveniles have also been reported to suffer mortality (McCrary and Bloom 1984, Crocoll and Parker 1989). Mortality has taken the form of wind-destroyed nests (Wiley 1975, Portnoy and Dodge 1979, Dijak et al. 1990), addled eggs (Janik and Mosher 1982, Crocoll and Parker 1989), starvation of nestlings (Crocoll and Parker 1989), human disturbance at or near the nest-site (Craighead and Craighead 1956, Wiley 1975), and predation of eggs, nestlings or adults (Craighead and Craighead 1956, Wiley 1975, Portnoy and Dodge 1979, Bosakowski and Speiser 1986, Crocoll and Parker 1989). The most frequent predators on eggs and young are raccoons (PROCYON LOTOR) and great horned owls (BUBO VIRGINIANUS).

Breeding density is highly variable; recorded values include one pair per 48.7 ha in central Maryland (Stewart 1949), one pair per 171 ha in western New York (Crocoll and Parker 1989), one pair per 417 ha in Massachusetts, one pair per 455-588 ha in Indiana, one pair per 645 ha in Michigan (Craighead and Craighead 1956), and 1 pair/1000 ha in Wisconsin (see Peterson and Crocoll 1992). Stewart (1949) found nests a mean distance of 1072 m apart in the wide upper Patuxent River drainage in Maryland, and Parker (1986) found similar internest distances in Missouri. Crocoll and Parker (1989) found nests a mean distance of 1271 m apart in the Canadaway Creek Wildlife Management Area of western New York.

Adjacent nests were 0.37-1.27 km apart in creek bottoms in southern California. Breeding home range of radio-tagged birds in California averaged 62 ha for males, 37 ha for females; used less space when not breeding. In northern New Jersey, nesting density was 0.22 nests per 100 ha, the highest density yet reported (about twice that reported in the few comparable studies in other states) (Bosakowski et al. 1992).

Often uses nests of previous years (Terres 1980). Nesting territories can be used for many years by a succession of pairs, even in the face of logging and (formerly) egg collecting. Bent (1937) reported an unbroken record of 26 years for a territory that was occupied for at least 42 years, until the woods were nearly ruined by cutting. His longest record was 47 years, but he knew of a tract that was occupied for over a half-century, from 1872 until 1923.

LEUCOCYTOZOA sp., a hematozoan, was detected in the blood of hawks tested in Oklahoma (Kocan et al. 1977). Two lice (COLPOCEPHALUM FLAVESCENS and PHILOPTERUS TAUROCEPHALUS) and one bird fly (LYNCHIA AMERICANA) have been found on red-shoulders (Peters 1936). In New York, the ears of nestlings commonly were full of maggots (PROTOCALLIPHORA SPLENDIDA) (Sargent 1938). These maggot infestations seemingly did not cause deafness or hinder survival (Hands et al. 1989).

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: North of a line roughly from southern Minnesota to the southern border of Ohio, to central New Hampshire, most red-shouldered hawks are resident only during the breeding season, though a few may overwinter in the region. The migratory tendency is expressed most strongly in the Northeast population, although there are also flights in the Midwest and Southeast, and a light fall movement in California. From the latitude of about Virginia southward, populations are mainly resident.

In Maryland, montane populations are migratory whereas those in the Piedmont and coastal areas are not.

Spring migration is early; birds move by 15 February in Maryland and the District of Columbia (Palmer 1988). Overall, the northward movement peaks in March. Migrants begin to arrive in Massachusetts in mid-March, in southwestern Quebec from March to mid-April. In Michigan, migrating birds arrive at nesting grounds between late February and early April.

Fall migration begins in early September in the Northeast, extending into November and even late December for a few tardy individuals. Dates are similar across the northern part of the range.

Typically avoids crossing large bodies of water (Palmer 1988).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Cropland/hedgerow, Forest - Hardwood, Forest - Mixed, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: BREEDING: varies from bottomland hardwoods and riparian areas (Stewart 1949, Henny et al. 1973, Bednarz and Dinsmore 1981, Kimmel and Fredrickson 1981, Woodrey 1986, Preston et al. 1989) to upland deciduous or mixed deciduous-conifer forest (Titus and Mosher 1981, Armstrong and Euler 1983, Morris and Lemon 1983, Crocoll and Parker 1989). Nesting areas are almost always found near some form of water, such as a swamp, marsh, river, or pond (Preston et al. 1989, Bosakowski et al. 1992), and the habitat is usually well forested (Portnoy and Dodge 1979, Kimmel and Fredrickson 1981, Titus and Mosher 1981, Morris and Lemon 1983, Ebbers 1989). Further, nesting habitat typically is mature forest with a well-developed high canopy and variable amounts of understory vegetation (Postupalsky 1980, Titus and Mosher 1981, Armstrong and Euler 1983, Morris and Lemon 1983, Titus 1984, Preston et al. 1989.). Sometimes occurs in coniferous stands in the West. In California, has been expanding range of occupied habitats to include various woodlands, including stands of eucalyptus trees amid urban sprawl (Ehrlich et al. 1992).

The nest is usually built in the main crotch of a large, living tree in mature forest, although in Florida, palmettos may be used. In eastern North America, nests generally are far from forest edges. At least 43 species of mainly deciduous trees have been chosen, so that the size and shape seem more important than the actual species (Bednarz 1979, Apfelbaum and Seelbach 1983, Titus and Mosher 1987, Palmer 1988, Ebbers 1989). The bulky structure of twigs, rather flat on top, is typically placed approximately halfway up the tree in the lower portion of the canopy (Morris et al. 1982, Titus and Mosher 1987). The typical height is between 11-15 m but can range from 1.5-33.5 m (Peck and James 1983, Ebbers 1989). The nest is lined with stems, leaves, lichen, and bark. Active nests are decorated with greenery and other materials. Hemlock and other conifer sprigs are often mentioned as nest greenery, as are deciduous sprigs once they have leafed out, and Bent (1937) mentioned such plants as flowering violets and nightshade. Other materials have included cornstalks, ears, and husks, dried tent caterpillar webs, tissue paper, twine, and nests of eastern wood-pewee, red-eyed vireo, and northern oriole (Palmer 1988).

In eastern North America, may use nest used previously by barred owl (STRIX VARIA) (and vice versa) (Palmer 1988). See Dijak et al. (1990) for information on nest-site characteristics affecting success and reuse of nests in Missouri.

NON-BREEDING: less restricted than that used for breeding; favors lowland areas near water, either standing or running, including river valleys, swamps, marshes, and perhaps canyon bottoms (Palmer 1988), and level, open country with scattered large trees (Bent 1937). In Florida, Bohall and Collopy (1984) found hawks most often in open areas such as pastures and fallow fields.
Adult Food Habits: Carnivore, Invertivore
Immature Food Habits: Carnivore, Invertivore
Food Comments: Diet varies regionally and seasonally, sometimes annually depending on availability. Common prey items include snakes of moderate size; amphibians up to bullfrog size; mammals mostly from shrew to chipmunk size; small lizards and young turtles; relatively few birds to grackle size; a few small fishes; a few crayfishes; insects in considerable numbers, usually of cricket and large grasshopper size; and miscellaneous invertebrates such as centipedes, earthworms, and snails (Palmer 1988). In northeastern North America, juvenile chipmunks are important prey during the hawk nestling period (Portnoy and Dodge 1979, Morris 1980, Johnson 1989, In Iowa, Bednarz and Dinsmore (1985) Iowa observed that the proportion of prey types changed dramatically between years, with mammals dominating one year and amphibians and arthropods the next year. Apparently the change in prey type had no effect on productivity between the two years.

Hunts beneath forest canopy and in more open nearby terrain that is preferably moist or near water; hunts from perch or flies low and attacks prey from close range (Palmer 1988). In Iowa, hunted in small clearings averaging a few hectares (see Bushman and Therres 1988).

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 48 centimeters
Weight: 643 grams

Global Status: G5
Global Status Last Reviewed: 22Nov1996
Global Status Last Changed: 22Nov1996
Rounded Global Status: G5 - Secure
Reasons: Species is apparently holding its own throughout most of the large range (S4 or S5 in many states), but populations are much depressed, especially in the north, compared to historic levels. Threats may increase over next decade because of demands on habitat for human use.

National Status: N5B,N5N
Delaware (S2B,S3N)

Stewardship Overview: A large woodland hawk, widespread in the eastern United States, extreme southeastern Canada, California and Mexico. Once the most common woodland hawk in the eastern region, this hawk is now much reduced in the northern part of its range. In many areas it has been replaced by the red-tailed hawk as the most common hawk. This decline came largely before 1970, and in the northeastern part of its range, some areas have seen the beginnings of recovery since that date. In the Northcentral states, the hawk is still declining, or stable at very low population size. In the southern part of its range, it is much more common. A species of large stands of mature hardwoods, or mixed hardwoods and conifers. It requires mature canopy structure with large, low-branching hardwoods for nesting, and prefers areas with wetland openings nearby. To maintain this species, particularly in its northern range, will require comprehensive forest management planning. Research on the status, productivity and response to various management practices is needed.

Restoration Potential: The potential for restoration in areas now devoted to agriculture or those now subject to urban/suburban sprawl is obviously low. The potential for recovery in forested and reforesting parts of its range is good (Crocoll and Parker 1988), but only if these forests are allowed to develop a mature canopy structure. It is also important to retain tracts sufficiently large to support breeding pairs. This will depend upon the cooperation of private landowners, as well as managers of public lands in each state. Compatible timber management may be possible, but has yet to be demonstrated. In Michigan, cooperative efforts by state forest and wildlife managers have begun and may provide the opportunity to monitor and develop compatible management of hardwood stands. Active management of land for hawks and preservation of large stands of mixed deciduous and coniferous trees are warranted to maintain viable populations of this species in the northern part of its range.

Preserve Selection & Design Considerations: Much of the literature indicates the need for large stands of forest for maintenance of breeding hawks. Bednarz and Dinsmore (1981) stated that red-shoulders needed a minimum of 250 ha of forest area for breeding in floodplain habitats. In most areas seem to need tracts of at least 100-250 ha (but may use smaller forest patch if it is part of a larger forested ecosystem) (Bushman and Therres 1988). Generally replaced by the red-tailed hawk in fragmented open forests. Bryant (1986), however, found that even in small woodlots of less than 5 ha red-shoulders were not replaced by red-tailed hawks when mature canopy structure was retained. Average size of woodlots occupied by red-shoulders in his southern Ontario study was only 17.5 ha. The necessary size of woodlot is clearly an issue that needs to be resolved. If large tracts are generally necessary, this requirement limits the potential for private land to provide refugia for this species. This is especially true in areas where urban or suburban development pressures are extreme. The large blocks of both upland and wetland forest in state and federal ownership in many states are therefore the most likely sites for the hawk. Reversion of abandoned farmland to forest offers potential future sites for reestablishment or expansion of present populations.

Management Requirements: While the urgency of special management is at present uneven across its range, over the long-run the requirement for mature forest habitat will continue to place it in jeopardy. Unless forest management plans take into account the special needs of the species, it is likely that the next round of forest harvest will impact hawks at least as severely as the first round. Starting from the current depressed populations, this could easily lead to the extirpation of this species from some regions. Management involves the management of both habitat and people. These procedures generally follow those for other forest-interior breeding birds (Bushman and Therres 1988), and recent management suggestions for the red-shouldered hawk specifically (Hands et al. 1989).

Timber practices have a significant impact on populations. Bednarz and Dinsmore (1981) maintained that tree densities on the order of 150 to 400 trees per acre are desirable. For the northeastern U.S., Peterson and Crocoll (1992) stated that selective cutting that creates small openings in large forest stands may be the best habitat management treatment. Robinson (1991) stated that uneven-age management with small clearings in bottomlands is best. However, too much selective cutting in woodlots may result in replacement of this species by red-tailed hawk. Group selection or standard selection cutting results in small openings scattered throughout a canopy of large overstory hardwoods (Nelson and Titus 1989) with an approximately 70% crown closure (Bushman and Therres 1988). Bryant (1986) theorized that managing for a crown closure of greater than 70% should prevent red-tailed hawks from displacing red-shouldered hawks. However, there is disagreement on the value of small clearings and the best structure of forests. Some studies show that small clearings benefit red-tailed hawks more than red-shoulders (Hands et al. 1989). Ebbers (1989) found that of two areas studied, the one with higher recruitment had taller nest trees, higher density and dominance indices; in other words, more mature forest structure. The latter study did not present forest structure in terms of canopy closure, but did present data showing that wetland openings averaged only 3% of habitat within a 1-km radius of 30 nest sites in northern Lower Michigan. Although no definitive management recommendations can yet be made, research suggests that establishment and maintenance of mature to overmature bottomland stands of at least 250 ha with > 70% crown closure, appropriately shaped nest trees, and open wetland inclusions should be the goal of red-shouldered management.

In active nesting areas, human use and passage should be minimized or prohibited during nesting season

(approximately March through July for the northern range). Disturbances in the nesting territory should be minimized until the young are at least two weeks old (Bushman and Therres 1988). The best size for an undisturbed buffer zone around nest sites is not well documented. Recorded distances between nests and human use areas range from 69 to 840 m. Evers (1992) recommmended that a distance of at least 300 ft from the nest should be kept free from human disturbance.

The Allegheny National Forest Land and Resource Management Plan contains guidelines for protecting raptor nests which Nelson and Titus (1989) contended would be useful for managing hawks. These include minimizing disturbances near nest sites, reducing habitat change and closing roads to public use during the breeding season. More details can be found in Nelson and Titus (1989). These management procedures and programs work best as part of a cohesive whole, aimed at management of forest ecosystems, and accomplished through a combination of public relations and education, agency rules and regulations, and environmental laws.

States in the Northeast should each establish a restoration/recovery program, based upon state and regional needs. Recovery teams should work with landowners and foresters to assure that group selection or standard selection cutting is used to best preserve habitat during silvicutural activities.
Monitoring Requirements: The Northeast Raptor Management Symposium and Workshop (Titus et al. 1989) concluded: "It might be that special surveys and research are required to monitor this species, and that BBS, CBC, and hawk migration count data are not suitable for detecting trends." Meaningful raptor surveys are difficult, but a number of methods have been devised and described (Fuller and Mosher 1987). Broadcast vocalizations (conspecific and great horned owl) can facilitate detection of this species in breeding habitat (Balding and Dibble 1984, Fuller and Mosher 1987, Bosakowski and Smith 1989, Preston et al. 1989, Johnson and Chambers 1990). Mosher et al. (1990) determined that broadcasting taped calls gives better results than walking or driving a survey route. A 5-minute call broadcast, followed by 5 minutes of listening proved sufficient to detect most hawks. Peterson and Crocoll (1992) recommended that this method be used to obtain needed population data in the northeastern U.S. See Iverson and Fuller (1991) for information on a method for obtaining a population index that may be useful in determining population trends.

The following paragraphs summarize some actions that would facilitate population monitoring and trend detection.

Data gathered by the Hawk Migration Association of North America should be entered in a central data repository and be made readily available to all researchers. Also, these data records should be better standardized as per the suggestions of Bednarz and Kerlinger (1989) and Titus et al. (1989).

Breeding bird atlases should be coordinated using a common block size and mapping system, and universal codes for breeding criteria. This effort should attempt to survey all blocks in each state or province. A scale for abundance of each species should be employed as was done in Ontario.

BBS data should continue to be gathered, and those routes within the range that are not being run should be activated as soon as possible. Nest sites should be mapped and data collected on each: territory; behavior; distance to nearest water, road, human structure, or known raptor nest; and the chicks banded if possible (Bowles et al. 1984).

Periodic surveys at several permanent survey locations should be conducted in the Northeast during the nesting and wintering periods to assess productivity, mortality, and population stability.

Regular monitoring of contaminant levels in eggs, young, and adults should be conducted, and the effects of these contaminants should be evaluated.
Management Research Needs: Determine the impact of human intrusion on breeding birds. Test the effect of different buffer zone sizes.

Obtain better information on specific habitat requirements for better management of viable populations. This is particularly important in the Northeast where red-shoulders are found in both bottomland floodplain forests and upland forests.

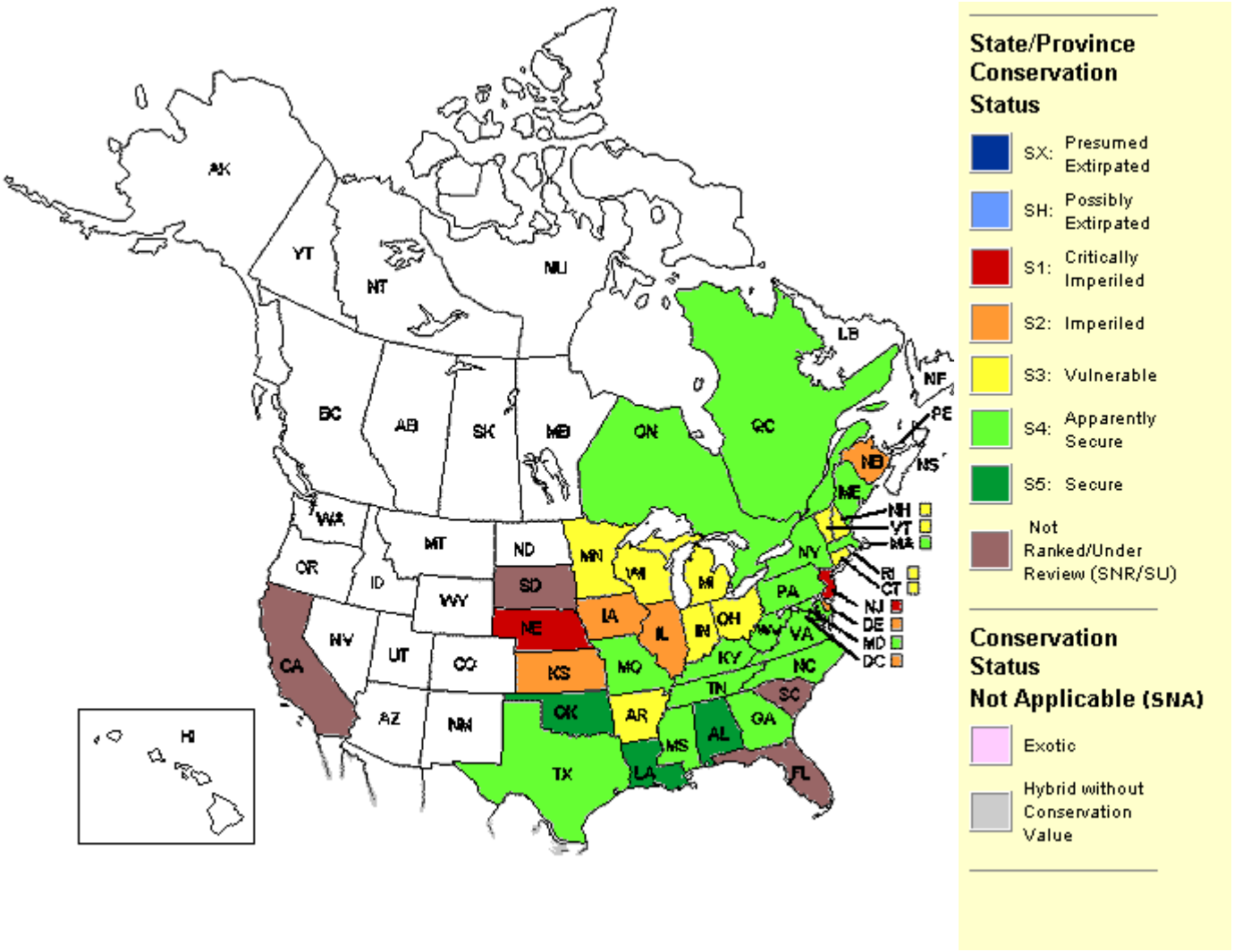
Determine the minimum size of a forest stand necessary to maintain a breeding pair or a viable population of red-shoulders.

Monitor the impact of red-tailed on red-shouldered hawks and study the effect of various silvicultural activities on adjacent pairs of each species.

Evaluate the importance of breeding and wintering habitat to the survival of red-shoulders. Which is more critical?

See Hands et al. (1989) for additional research and management needs.
Biological Research Needs: Migratory routes and wintering areas in particular should be better identified.

All information courtesy of NatureServe.org:
http://www.natureserve.org/explorer/servlet/NatureServe?menuselect=none&sourceTemplate=tabular_report.wmt&loadTemplate=species_RptComprehensive.wmt&selectedReport=RptComprehensive.wmt&summaryView=tabular_report.wmt&elKey=103156&paging=home&save=true&startIndex=1&nextStartIndex=1&reset=false&offPageSelectedElKey=103156&offPageSelectedElType=species&offPageYesNo=true&post_processes=&radiobutton=radiobutton&selectedIndexes=103156&menuselectfooter=none


State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
Not Applicable (SNA)
Exotic
Hybrid without Conservation Value
AK
YT
NT
NU
BC
AB
SK
MB
ON
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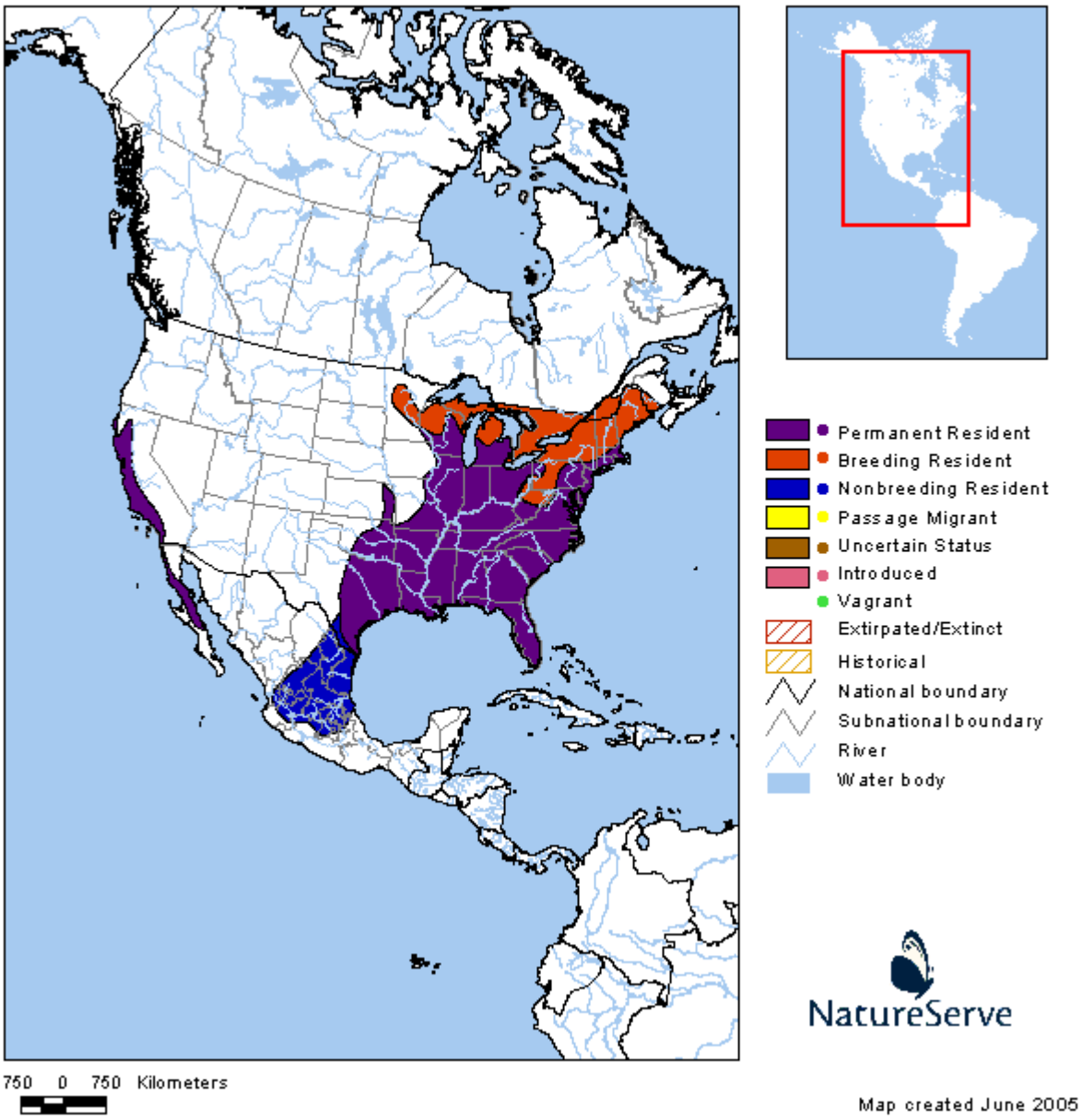
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Catharus fuscescens - (Stephens, 1817)
Veery

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Turdidae	Catharus

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Catharus fuscescens
Taxonomic Comments: Formerly placed in genus HYLOCICHLA (AOU 1983).

Short General Description: A bird (thrush).

General Description: An 18-cm-long bird with a reddish brown dorsum, white belly, gray flanks, grayish face, small spots (often indistinct) on the breast, indistinct grayish eyering, and straight slim bill. Western populations have a darker dorsum and more breast spotting than do eastern populations.

Diagnostic Characteristics: Differs from other thrushes in having less breast spotting (less distinct and more restricted). Differs from Pacific coast populations of Swainson's thrush (CATHARUS

USTULATUS) in having gray (vs. buffy brown) flanks.

Reproduction Comments: Eggs are laid in May-June. Clutch size is three to five (usually four). Incubation lasts 11-12 days, by female. Young are tended by both parents, leave nest at 10-12 days.

Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Arrives in the southern U.S. in April, still common in migration mid-May, on northern nesting grounds by late April-early May (Terres 1980). Costa Rica: uncommon to sporadically common fall transient (late September-late October), rare spring transient (March-April) (Stiles and Skutch 1989).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Shrubland/chaparral, Woodland - Hardwood, Woodland - Mixed

Habitat Comments:
BREEDING: Poplar, aspen, or other swampy forest, especially in more open areas with shrubby understory, also in second growth, willow or alder shrubbery near water; large tracts of forest are most suitable. Nests usually on or near ground, at base of shrub, in clump of weeds, in shrub or low tree (Terres 1980).

NON-BREEDING: In migration and winter also in lowland forest, woodland, and scrub.

Adult Food Habits: Frugivore, Invertivore

Immature Food Habits: Frugivore, Invertivore

Food Comments: Eats insects and other invertebrates and small fruits; forages on forest floor and in trees (Terres 1980), often near water (Stiles and Skutch 1989). Takes many fruits during migration (Stiles and Skutch 1989).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Length: 18 centimeters
Weight: 31 grams

Global Status: G5
Global Status Last Reviewed: 03Dec1996
Global Status Last Changed: 03Dec1996
Rounded Global Status: G5 - Secure

Reasons: Declining in some areas, but still very widespread and common in many other areas; overall, population evidently is stable and secure.

National Status: N5B
State Status: Delaware (S2B)

Preserve Selection & Design Considerations: Classified as area sensitive (i.e., occurs more frequently or at higher population density as forest size increases) by Freemark and Collins (1992), but other data on area-sensitivity inconsistent (see Askins et al. 1987, Robbins et al. 1989, Blake 1991). In Illinois, nesting occurred in forest patches of 27-1000+ ha; only two of 22 patches were smaller than 100 ha; mean patch size was 309 ha; patches used for nesting tended to be surrounded by other forested habitat (Herkert 1995). In Wisconsin, nesting was much more likely in forest patches larger than 100 ha than in smaller patches (Temple, cited by Herkert 1995). Robbins et al. (1989) found that nesting in the mid-Atlantic states was most likely in forest patches of 3000 ha or larger but breeding sometimes occurred in patches as small as nine ha. Associated with large (> 8 ha) aspen groves in Saskatchewan (Johns 1993).
Management Requirements: Litwin and Smith (1992): nesting population in Sapsucker Woods, Ithaca, NY declined 58% from 1950-1980, correlated with maturation of forest, decline in density of shrub layers and decline in overall vertical and horizontal structural heterogeneity; implies that some disturbance may be necessary to maintain suitable nesting habitat.

Benefits from logging (Maurer et al. 1981, Webb et al. 1977).

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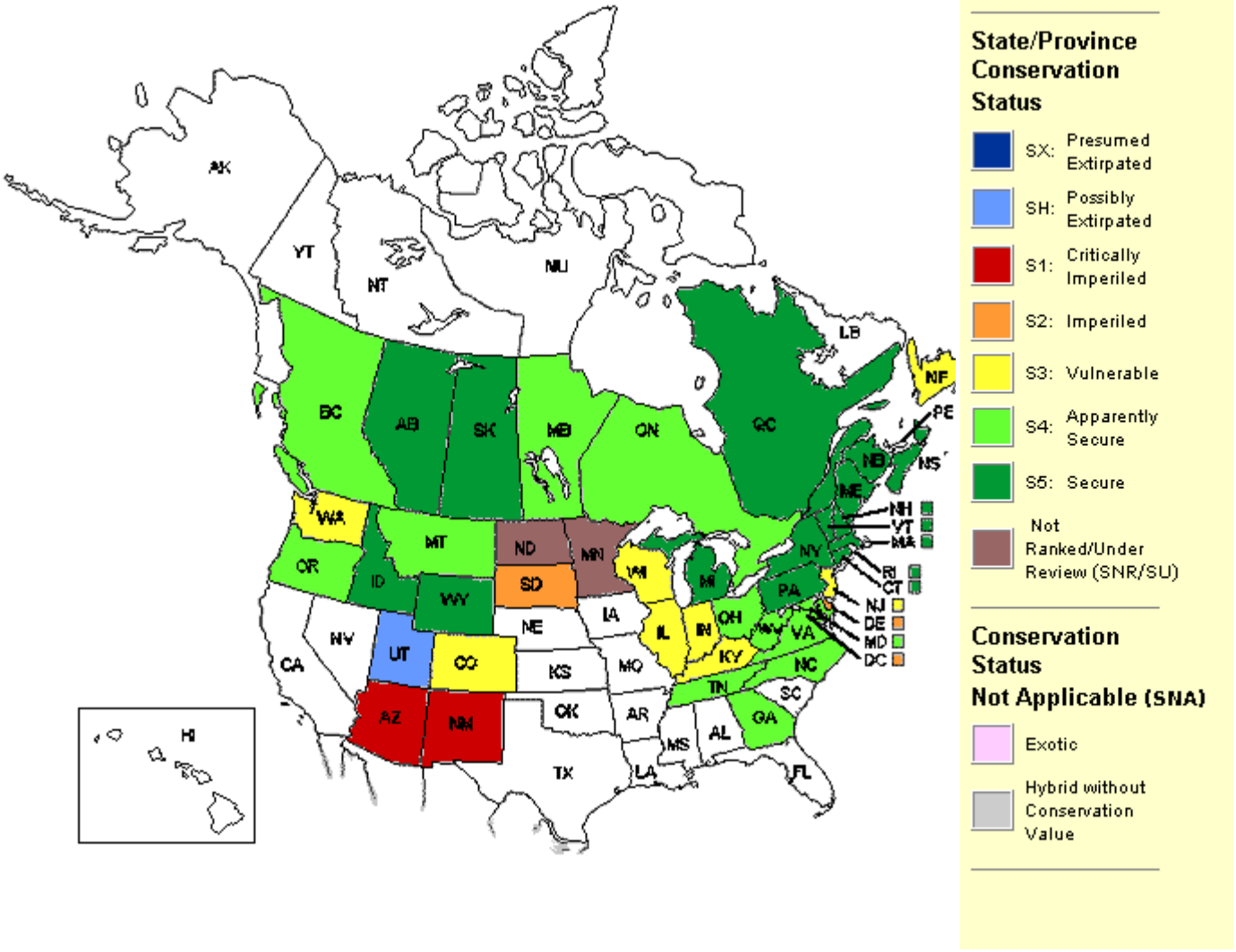
State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
Not Applicable (SNA)
Exotic
Hybrid without Conservation Value
AK
YT
NT
NU
BC
AB
SK
MB
ON
QC
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NS
NB
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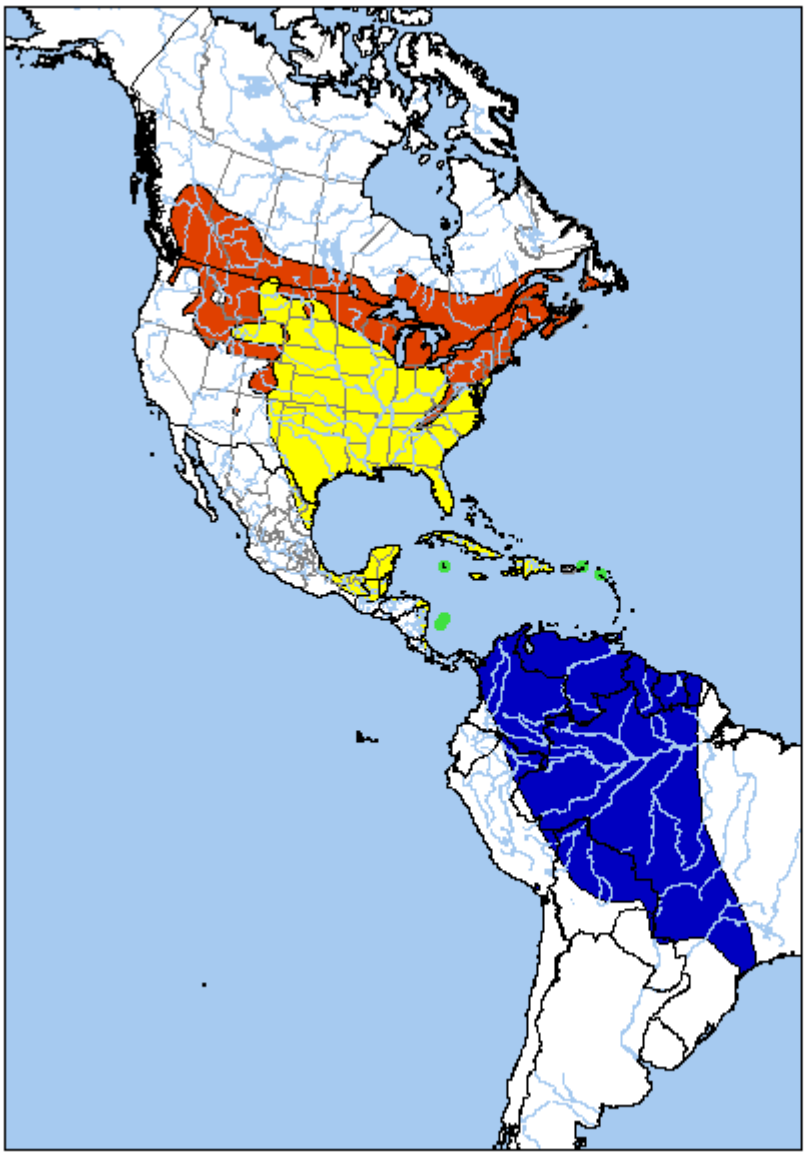


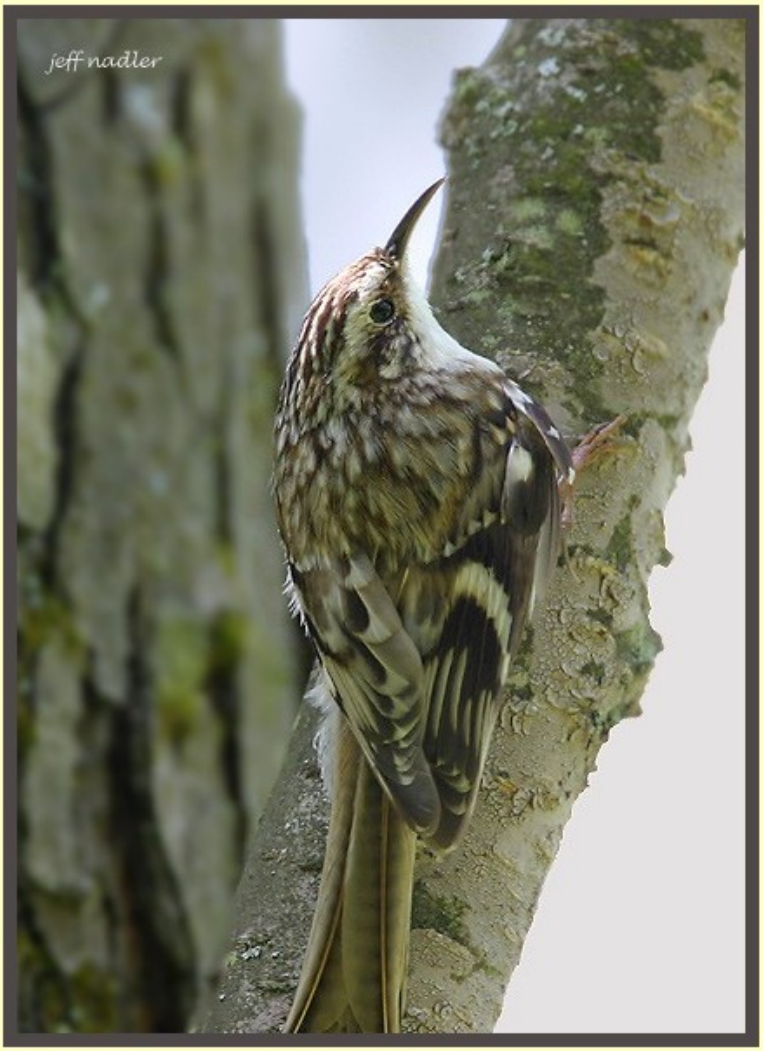
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body

NatureServe

750 0 750 Kilometers

Map created June 2005

Certhia americana - Bonaparte, 1838
Brown Creeper



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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Certhiidae	Certhia

Genus Size: B - Very small genus (2-5 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Certhia americana
Taxonomic Comments: Formerly regarded as conspecific with Eurasian C. FAMILIARIS; however, may be more closely related to C. BRACHYDACTYLA (AOU 1998).

Short General Description: Small, drab, woodland, bark-gleaning songbird.

Reproduction Comments: Four to eight eggs, most commonly five or six, are laid (Bent 1948, Davis 1978). Incubation begins once the entire clutch is laid (Davis 1978). Incubation lasts 14 to 17 days, but 15 is apparently most common (Davis 1978). Young fledge in 15 to 16 days, and are fed by both parents for about two more weeks.

Davis (1978) found that 58% of nests with at least one egg or nestling (out of 19 observed) succeeded in fledging young. Survival rates, calculated from a total of 94 eggs laid were 60% from laying to hatching, and 94% from hatching to fledging, or 52% overall (from laying to fledging).

Ecology Comments:
Territories ranged from 2.3 to 6.4 ha in a study in Michigan (Davis 1978). Rough approximations of density, calculated from maps of nest locations at the study sites in Davis (1978) yielded these figures for three study sites: two ha per pair, and 1.5 ha per pair for two areas of swamp forest habitat; 5.6 ha per pair in a more upland site. In the latter area, nests were close to streams, so that the area of appropriate habitat may have been smaller than the overall study area, and 5.6 ha per pair may be exaggerated by the inclusion of inappropriate habitat away from streams.

Few observations of predators appear in the literature. One incidence of a creeper chased (but not captured) by a northern shrike is recounted in Bent (1948). Creepers are known to respond defensively to the scream of a hawk (Bent 1948, Davis 1978).

NON-BREEDING: Bent (1948) reported that creepers are quite solitary, but there have been reports of communal roosting and huddling in winter. Fledglings roost in a characteristic huddle (Davis 1978, Ryser 1985). They were reported to move in mixed-species flocks in the winter in Louisiana, Maryland, and in summer in Maine (Morse 1970). In Louisiana, they were nearly always observed in mixed-species flocks in winter rather than singly (Morse 1970).

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: South of a line from southeastern British Columbia, North Dakota, Minnesota, Ontario, to Nova Scotia, are year round residents and do not migrate. In the mountains of the west they undertake altitudinal seasonal migrations, moving down into the foothills and valleys during the winter (Ryser 1985). In the vicinity of Bozeman, Montana, elevational movements occur Feb 20 to Apr 20 and Sep 10 to Oct 30).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Forest - Conifer, Forest - Hardwood, Forest - Mixed, Suburban/orchard, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Preferred habitat includes forest, woodlands, forested floodplains and swamps. Scrub and parks are also used in winter and during migration. Most often found in coniferous and mixed forests. A study by Franzreb (1985) describes the habitat in Arizona as mixed-coniferous forest, dominated by Douglas-fir, ponderosa pine and southwestern white pine. Within the habitat, birds selected the largest (tallest) trees most often for foraging. Hejl (pers. comm.) reported finding larger numbers in western redcedar stands than in the Douglas-fir/ponderosa pine stands in 1992 field work.

In the eastern U.S. south of the northern conifer zone, populations occur regularly in forested floodplains, and sometimes swamps. Hamas (pers. comm.), based on his experience, suggested that floodplain forests may be important habitat in Michigan. Davis (1978) studied populations in Michigan in two different forest types. One was an old white cedar, balsam fir, and black spruce swamp, with components of sugar maple, red maple, white pine, basswood and paper birch. The other was more topographically varied and drier; tree species included red maple, American beech, with less common white oak, eastern hemlock, large-toothed aspen, butternut hickory, and American elm. In the wetter areas of this site, dead American elms were common, and in the wettest areas, white cedar and eastern hemlock occurred. Davis (1978) found that all nests were in dead trees, and all nest trees were near water. Two were in swamps, while all others were within 60 m of flowing streams.

A component of dead trees is essential for nesting, so brown creepers tend to be associated with older forests. Hejl and Woods (1991) found them in old growth forests (200+ yr), but never in rotation-aged (80 to 120 yr) Douglas- fir/ponderosa pine stands in western Montana and adjacent Idaho. The birds have also been known to move into areas where many trees have died due to flooding or disease (Bent 1948).

Temporary positive impacts have been created by Dutch elm and other forest diseases, and by artificial floodings in forested areas. Both diseases and floodings leave standing dead wood and create large numbers of good nesting sites. However, the suitability of the habitat is, of course, only temporary in these situations. Creepers have been reported to become abundant in such situations (Bent 1948, Davis 1978, Nicholson pers. comm.), suggesting a certain degree of opportunism. Forest, woodland, swamps; also scrub and parks in winter and migration. Negatively impacted by forest fragmentation in southern Wyoming (Keller and Anderson 1992).

Nests usually behind loose slab of bark still attached to living or dead tree, average of 1.5-5 m above ground (Harrison 1979). Also occasionally in knot holes when loose bark is not available (Bent 1948). One observer (Bent 1948) noted that nests were often under the only remaining piece of bark on a dead tree. Davis (1978) found that tree canopy was partially open at each nest site in a Michigan study.

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Creepers feed on arthropods gleaned off the surface and in the crevices of tree bark. They feed primarily on the main trunk of trees, moving from bottom to top, almost invariably forward and upward, and then flying to a low point on the next tree when branch density begins to restrict their movement (Willson 1970). Willson (1970) found that brown creepers in southern Illinois had highly specialized feeding behavior. Among a group of six bird species that all fed on insects from tree trunk or branch gleaning, creepers were the most specialized to feeding site in terms of tree structure in both winter and spring. While they favored oaks and maple in winter, and hackberry in spring, they also used several other species fairly equally in spring (i.e. they were less fussy about tree species in spring) (Willson 1970). Eats mainly insects and other invertebrates, including immature stages, obtained from bark of tree trunks and branches; also eats some nuts and seeds (Terres 1980).

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 13 centimeters
Weight: 8 grams

Global Status: G5
Global Status Last Reviewed: 02Dec1996
Global Status Last Changed: 02Dec1996
Rounded Global Status: G5 - Secure
Reasons: Widespread, reasonably common, and demonstrably secure in many areas of North America; likely to be missed in standard surveys, and so may be underestimated in some counts; not particularly threatened globally at present.

National Status: N5
State Status: Delaware (S1B,S4N)

Stewardship Overview: This small bark-gleaning bird primarily inhabits northern coniferous forests, but is opportunistic enough to take advantage of large stands of dying timber of other types on occasion, especially on the southern periphery of its range. It is rarest in the south-central portions of its range, from the western Appalachians to the eastern edge of the Great Plains. In this region, attention to maintenance of a standing deadwood component in forest stands is critical. Elsewhere, though special protection and management may not currently be warranted for this relatively common bird, long term management should provide for standing deadwood. In Oregon, and apparently in Vermont and Connecticut, marked declines have occurred in recent years, presumably in response to logging of old growth stands. In Oregon, probably Washington, and wherever else old growth stands are being logged, compatible management plans are especially important for survival. Preservation of small old growth stands by purchase is not likely to be an adequate protection tool because of its tendency toward low-density populations.

Restoration Potential: A change of forest management practices to favor maintenance of a standing dead wood component and to reduce forest fragmentation would be beneficial, and is feasible.

Preserve Selection & Design Considerations: The appropriate size for a preserve is unknown, but is believed to be large. Peterjohn and Rice (1991) observed that "nesting creepers are occupants of extensive woodlands and will not be found in isolated woodlots and narrow wooded corridors." Negatively impacted by forest fragmentation in southern Wyoming (Keller and Anderson 1992). Measured territories ranged up to about 6.5 ha per pair (Davis 1978). This can be used as a guideline to establish minimum preserve size until more studies have been completed.

Management Requirements: Brown creepers require that the dead tree component in forests be allowed and encouraged. The coniferous, mixed species character of forests should be maintained where populations reside. Best to protect or manage stands to have at least some trees or groves of trees over 100 years old to have dead trees with flaking bark for nest sites (Ewert, unpubl. MS). Response to burning: more common on unburned plots in breeding season in Arizona (Finch et al. 1997).

Monitoring Requirements: In light of the minimal amount of information on population status, and the suggestion of slow decline in the Breeding Bird Survey data, periodic monitoring across the range, plus extra effort where intense logging is ongoing, or where populations have declined or are expected to decline, is warranted. Surveys specific to this species are needed because Breeding Bird Survey is not very effective for this elusive, low density species. Brown creepers are perhaps best monitored in conjunction with research on neotropical migrants because they co-occur in mixed flocks during migration.

Management Research Needs: Management research needs include determination of the appropriate size for a preserve, investigation of the effects of forest management practices in different forest types, and knowledge of population dynamics.

Biological Research Needs: Determine size of tract necessary to attract a breeding pair and size of area required to maintain viable sub-populations, metapopulations, etc. Determine response to various forest management practices.

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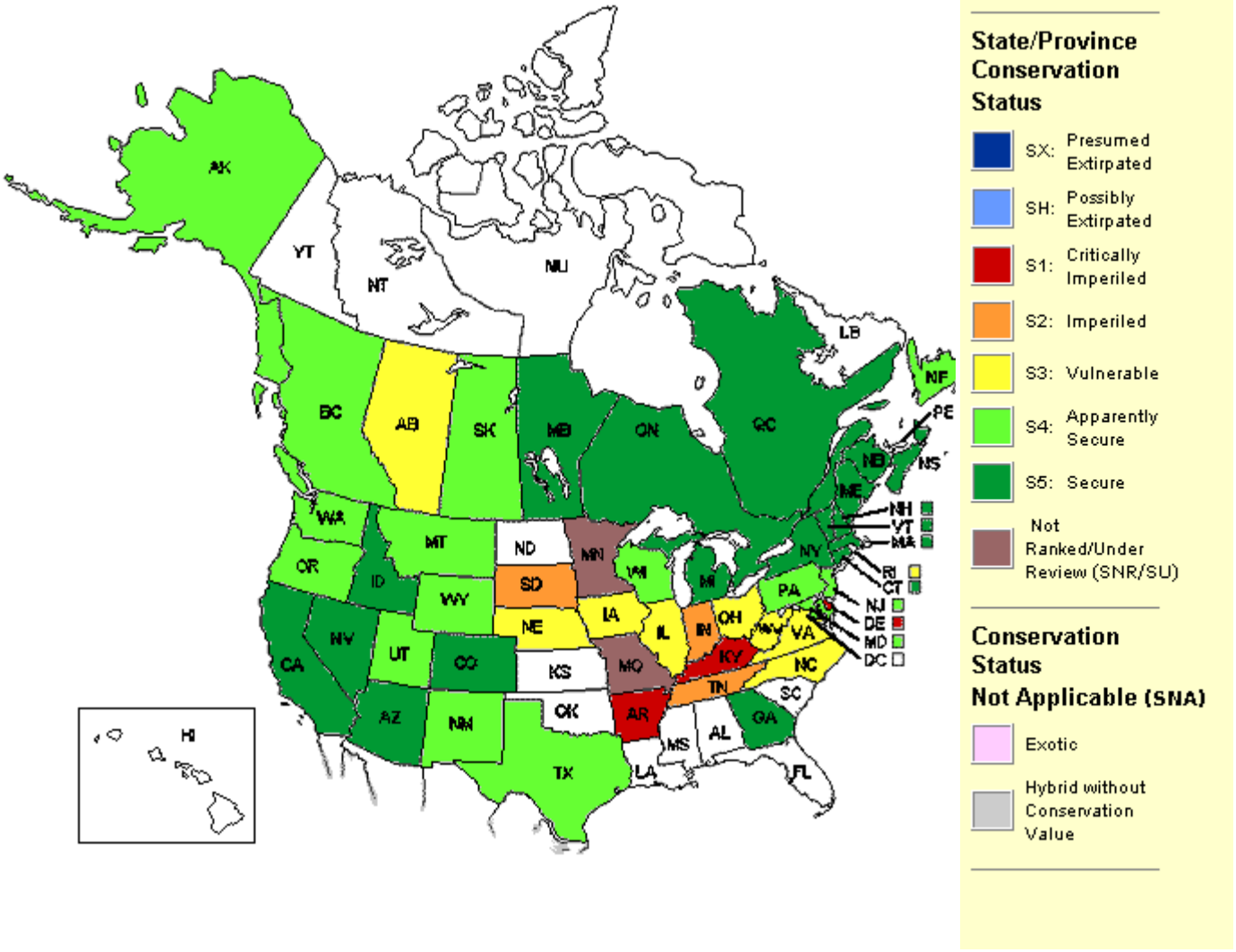
State/Province Conservation Status
SX: Presumed Extirpated
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S1: Critically Imperiled
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S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
Not Applicable (SNA)
Exotic
Hybrid without Conservation Value
AK
YT
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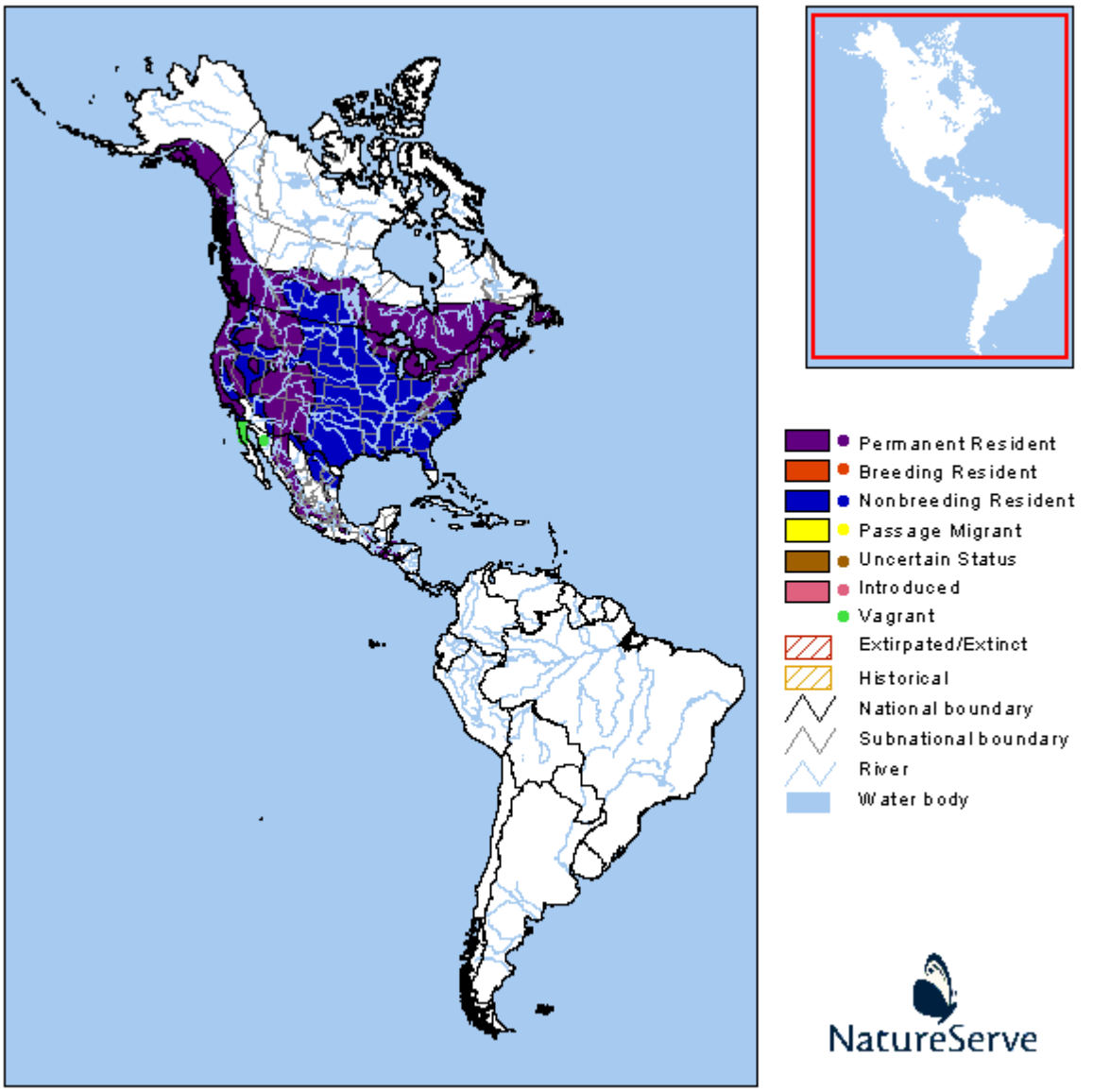
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Haliaeetus leucocephalus - (Linnaeus, 1766)
Bald Eagle

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Falconiformes	Accipitridae	Haliaeetus

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Haliaeetus leucocephalus
Taxonomic Comments: The two subspecies, H. L. LEUCOCEPHALUS (southern U.S. and Baja California) and H. L. ALASCANUS (northern U.S. and Canada) intergrade broadly in the central and northern U.S. Constitutes a superspecies with H. ALBICILLA (AOU 1998).

Short General Description: Bald eagle. Mature adults have a white head and tail.

General Description: Adults have a white head, white tail, and a large bright yellow bill; elsewhere the plumage is dark. Immatures are dark with variable amounts of light splotching on the body, underwing

coverts, flight feathers, and tail base; averages 79-94 cm long, 178-229 cm wingspan (NGS 1983).

Diagnostic Characteristics: Adults differ from other eagles in having both a white head and white tail (head of white-tailed eagle may look white at a distance). Bald eagle has a proportionately larger head and bill than does the golden eagle, in the immatures of which the white is confined to the base of the primaries and the base of the tail. Bald eagle lacks the long wedge-shaped tail of Steller's sea-eagle. Bald eagle's neck is shorter and tail is longer than in white-tailed eagle.

Reproduction Comments: Clutch size is 1-3 (usually 2). Incubation lasts about 5 weeks, by both sexes. Second hatched young often dies. Young first fly at 10-12.5 weeks, cared for by adults and may remain around nest for several weeks after fledging. Generally first breeds at about 5-6 years. Adults may not lay every year.

Ecology Comments:
Commonly roosts communally, especially in winter. See Curnutt (1992) for information on the dynamics of a year-round communal roost in southern Florida.

In Montana, the introduction of shrimp (MYSIS RELICTA) had a cascading effect through the food chain, ultimately causing displacement of bald eagles (Spencer et al. 1991).

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: Most eagles that breed in Canada and the northern U.S. move south for winter. Migrates widely over most of North America (AOU 1983); moves generally E-SE across Canada and the Great Lakes region to the northeast coast of the U.S. In the northern Chesapeake Bay region, radio-tagged northern migrants arrived in late fall (mean date 21 December) and departed in early spring (mean date 27 March); radio-tagged southern migrants arrived throughout April-August and departed June-October (Buehler et al. 1991). See Palmer (1988) for fairly detailed review of seasonal movements in various regions.

Defended territories are relatively small; fourteen in Alaska varied from 11-45 hectares and averaged 23 ha (Hensel and Troyer 1964), and territory radius around active nests averaged 0.6 km in Minnesota (Mahaffy and Frenzel 1987). Feeding home ranges surrounding active nests are undoubtedly much larger, depending on proximity to food sources and abundance of food. Minimum home range of breeding birds in Saskatchewan was 7 square kilometers (Gerrard et al. 1992); on the Columbia River, Oregon, breeding home ranges averaged 21.6 square kilometers (Garrett et al. 1993).

Winter home ranges can be very large, especially for nonbreeding birds. An immature wintered in Arizona over an area of >40,000 square kilometers and spent the summer in the Northwest Territories over a summer range of >55,000 square kilometers (Grubb et al. 1994). Maximum distance between feeding area and night roost site was less than 16 km in winter in Missouri (Griffin et al. 1982). In north-central Arizona, February-April home range of immatures averaged 400 square kilometers; birds moved frequently and roosted singly or in small groups (Grubb et al. 1989).

Marine Habitat(s): Near shore

Estuarine Habitat(s): Bay/sound, Lagoon, River mouth/tidal river, Tidal flat/shore

Riverine Habitat(s): BIG RIVER, MEDIUM RIVER

Lacustrine Habitat(s): Deep water, Shallow water

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Cliff, Forest - Conifer, Forest - Hardwood, Forest - Mixed, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Breeding habitat most commonly includes areas close to (within 4km) coastal areas, bays, rivers, lakes, or other bodies of water that reflect the general availability of primary food sources including fish, waterfowl, and seabirds (Andrew and Mosher 1982, Green 1985, Campbell et al. 1990). Preferentially roosts in conifers or other sheltered sites in winter in some areas; typically selects the larger, more accessible trees (Buehler et al. 1991, 1992). Perching in deciduous and coniferous trees is equally common in other areas (e.g., Bowerman et al. 1993). Communal roost sites used by two or more eagles are common, and some may be used by 100 or more eagles during periods of high use. Winter roost sites vary in their proximity to food resources (up to 33 km) and may be determined to some extent by a preference for a warmer microclimate at these sites. Available data indicate that energy conservation may or may not be an important factor in roost-site selection (Buehler et al. 1991). In Saskatchewan lakes, density was positively correlated with abundance of large fishes (Dzus and Gerrard 1993). In winter, may associate with waterfowl concentrations or congregate in areas with abundant dead fish (Griffin et al. 1982); often roosts communally at night in trees that are used in successive years. Wintering areas are commonly associated with open water though in some areas eagles use habitats with little or no open water if other food resources (e.g. rabbit or deer carrion) are readily available. Avoids areas with nearby human activity (boat traffic, pedestrians) and development (buildings) (Buehler et al. 1991). BREEDING: Usually nests in tall trees or on cliffs near water. Nest trees include pines, spruce, firs, cottonwoods, oaks, populars, and beech. Ground nesting has been reported on the Aleutian Islands in Alaska, in Canada's Northwest Territories, and in Ohio, Michigan, and Texas. Nests located on cliffs and rock pinnacles have been reported historically in California, Kansas, Nevada, New Mexico and Utah, but currently are known to occur only in Alaska and Arizona. Same nest may be used year after year, or may alternate between two nest sites in successive years. In British Columbia, nests with overhead canopy of foliage were most successful (Palmer 1988). See Livingston et al. (1990) for model of nesting habitat in Maine, Wood et al. (1989) for characteristics of nesting habitat in Florida (most nests in live pine trees). In Oregon, most nests were within 1.6 km of water, usually in largest tree in stand (Anthony and Isaacs 1989). In Colorado and Wyoming, forest stands containing nest trees varied from old-growth ponderosa pine to narrow strips of riparian vegetation surrounded by rangeland (Kralovec et al. 1992).

Adult Food Habits: Carnivore, Piscivore

Immature Food Habits: Carnivore, Piscivore

Food Comments: Feeds opportunistically on fishes, injured waterfowl and seabirds, various mammals, and carrion (Terres 1980). See Haywood and Ohmart (1986), Kralovec et al. (1992), Brown (1993), and Grubb (1995) for diet of inland breeding populations in Arizona, Colorado, and Wyoming. Hunts live prey, scavenges, and pirates food from other birds (e.g., osprey) and, in Alaska, sea otter (Watt et al. 1995, Condor 97:588-590). See Palmer (1988) for further information on hunting methods. In the Columbia River estuary, tidal flats and water less than 4 m deep were important foraging habitats (Watson et al. 1991). See Caton et al. (1992) for information on foraging perches used in Montana. Sheep carcasses were significant food sources in winter in Oregon (Marr et al. 1995, Wilson Bulletin 107:251-257).

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Phenology Comments: In the Columbia River estuary, foraging activity was most common at low tide and first daylight (Watson et al. 1991). In Arizona, foraging activity during the breeding season peaked at 0800-1000 and 1600-1900 MST (Grubb 1995).

Length: 94 centimeters
Weight: 5244 grams

Global Status: G5
Global Status Last Reviewed: 11Mar2005
Global Status Last Changed: 11Mar2005
Rounded Global Status: G5 - Secure
Reasons: Widespread distribution in North America; large numbers of occurrences, many of high quality, particularly in Alaska and British Columbia, but suffered great decline in southern and eastern part of range earlier this century; still susceptible to a number of threats, particularly environmental contaminants and excessive disturbance by humans; recent rangewide improvement in numbers and the protection offered by governments prevent it from being ranked any higher.

National Status: N5B,N5N
State Status: Delaware (S2B,S3N)

Management Requirements: Recovery has been assisted by intensive management that included systematic monitoring, enhanced protection, captive breeding, relocation of wild birds, and publicity (Matthews and Moseley 1990).

Knight and Knight (1984) recommended a 450 m buffer between a human in a canoe and a feeding eagle. For northern Chesapeake Bay, Buehler et al. (1991) recommended a 1360-m-wide shoreline management zone that extends 1400 m inland to encompass nonbreeding roost sites and provide a buffer from human disturbance. Another study recommended a 250-m buffer between a human on land and an eagle in a shoreline tree. A 500-m buffer around the nest may be adequate (see Fraser et al. 1985). In Michigan, 75% of all alert and flight responses to human activity occurred when activity was within 500 m and 200 m, respectively; vehicles and pedestrians elicited the highest response frequencies. Anthony and Isaacs (1989) made recommendations for Oregon: size of areas for nest-site management should be 50-250 ha, with size and shape depending on surrounding vegetation, topography, and eagle behavior; human

activities within 800 m of nests should be restricted from 1 January to 31 August; clearcut logging, road building, hiking trails, and boat launch facilities should not be allowed within 400 m of nests. In Arizona, pedestrians were the most disturbing human activity; eagles were more often flushed from perches than from nests and were most easily disturbed when foraging; eagle response to disturbance frequencies were 64% at distances less than 216 m, 45% at 216-583 m, and 24% at distances greater than 583 m (Grubb and King 1991). Along northern Chesapeake Bay, flush distances because of approaching boats averaged 204 m in winter, 176 m in summer (Buehler et al. 1991, which see for further information on the effects of human activity).

In the Columbia River estuary, management of eagle foraging habitats should emphasize protection and enhancement of tidal flats (Watson et al. 1991).

See Busch (1988) for a discussion of management activities in the southwestern U.S., Lefranc and Glinski (1988) for management recommendations.

Supplemental feeding can be used in efforts to replace diminished supplies of natural foods, provide food free of environmental contaminants, provide essential nutrients, enhance survival of subadults, manipulate distribution of populations, increase nesting success, support released captive-bred birds, and/or afford opportunities for public viewing and education; potential disadvantages of supplemental feeding include prohibitive costs, the loss of natural and cautious behavior, dependence on these food supplies which may alter migration patterns, and increased potential for disease transmission (Knight and Anderson 1990).

See Grubb (1980) for information on construction and use of an artificial nest structure.
Monitoring Requirements: See Fraser et al. (1983) for information on scheduling reproductive surveys. See Britten et al. (1995) for information on satellite telemetry.

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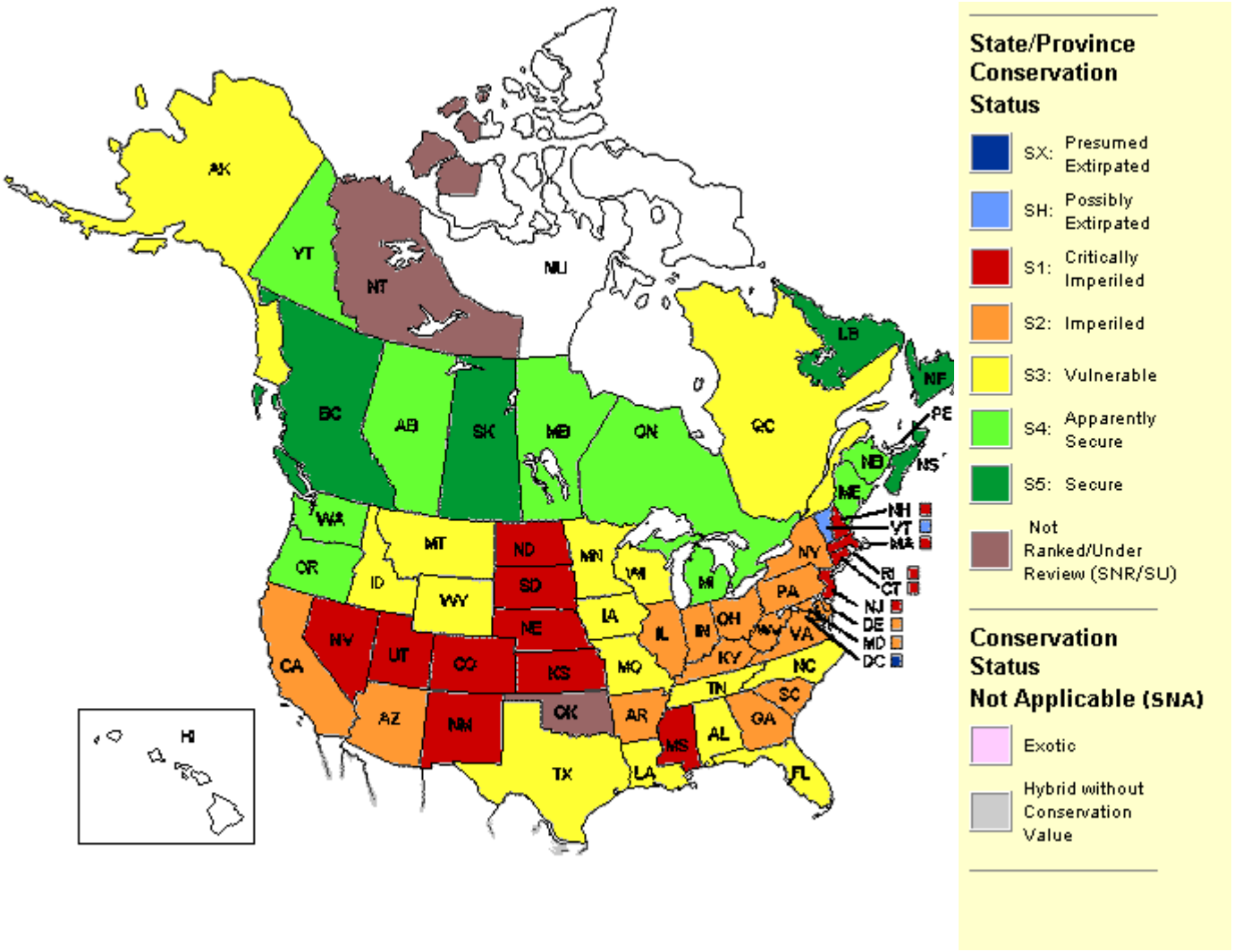
State/Province Conservation Status
SX: Presumed Extirpated
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Conservation Status
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Exotic
Hybrid without Conservation Value
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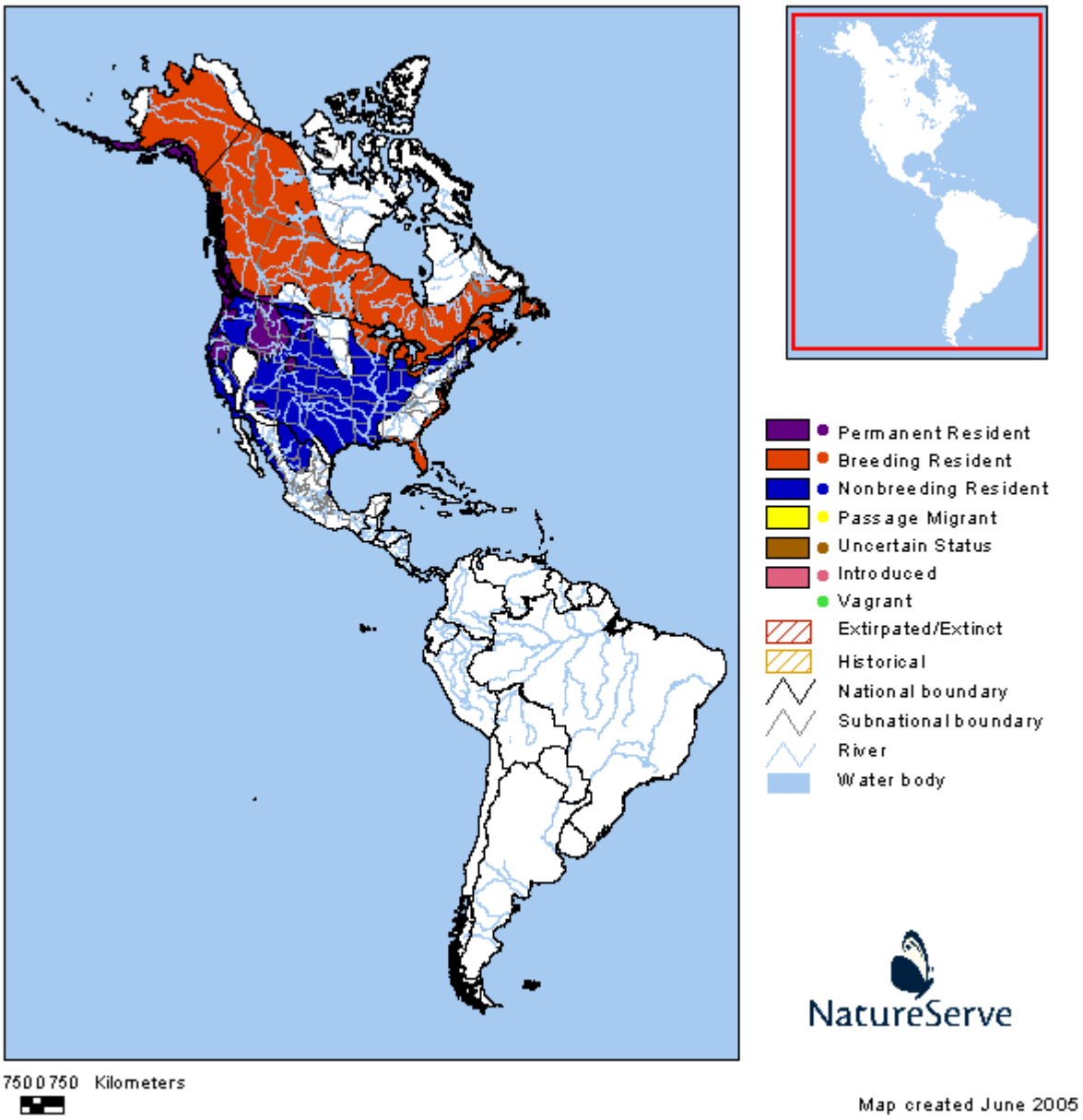
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
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Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Hylocichla mustelina - (Gmelin, 1789)
Wood Thrush

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Turdidae	Hylocichla

Genus Size: A - Monotypic genus
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Hylocichla mustelina
Taxonomic Comments: See Winker and Rappole (1988) for discussion of evidence indicating that the wood thrush does not warrant recognition as a genus (i.e., HYLOCICHLA) separate from CATHARUS.

Short General Description: A 20-cm bird (thrush).

General Description: Length 20 cm. Sexes similar. Reddish-brown above, brightest on crown and nape; rump and tail brownish-olive. Bold white eye ring conspicuous on streaked face. Whitish below, with large dark spots on throat, breast, and sides.

VOCALIZATIONS: Loud, liquid song of three- to five-note phrases, most notes differing in pitch, each phrase usually ending with a complex trill. Calls include a rapid "pit pit pit" (NGS 1987).

NEST: firm, compact cup of grasses, bark, moss, paper, mixed with leaf mold, mud; molded by contours of female's body; lined with rootlets. Outside diameter 10.2-14 cm, height 5.1-14.6 cm; inside diameter 7 x 8.3 cm, depth 3.2-5.1 cm.

EGGS: average size 25.4 x 18.6 mm; typically oval; shell is smooth, has slight gloss; pale blue or bluish green and unmarked.

Diagnostic Characteristics: Smaller than American Robin (TURDUS MIGRATORIUS) and plumper than the other brown thrushes (Gray-cheeked Thrush [CATHARUS MINIMUS], Bicknell's Thrush [CATHARUS BICKNELLI], Swainson's Thrush [CATHARUS USTULATUS], Hermit Thrush [CATHARUS GUTTATUS], and Veery [CATHARUS FUSCESCENS]). Distinguished by the deepening redness about the head and the larger, more numerous round spots on the breast. Nest is similar to that of robin but is smaller and invariably has leaves in foundation and rootlets instead of grass in lining. Eggs are smaller and generally more pointed at one end than are robin eggs; also slightly paler than robin eggs (Harrison 1975).

Reproduction Comments: Nesting occurs in late spring and early summer. In Delaware, nesting peaks occurred in the last week of May and in the second week of July (Longcore and Jones 1969). Nest site selection and building is by the female alone; complete in about five days. No evidence birds ever use nest a second time. Clutch size is 2-5 (usually 3-4). Individual females typically produce two broods per year. Incubation, by female, lasts 12-14 days. Male usually guards nest when female absent. Young are tended by both parents, leave nest at 12-13 days. Pair remains together for second nesting (Harrison 1975). There is some evidence of occasional polygyny (Johnson et al. 1991).

In Delaware, of 142 "nesting attempts," 38% were successful and 58% of nests were destroyed by predators. The greatest nest success was associated with late season nests, spicebush and black gum vegetation, and with lower nest height (below 8.5 ft); 33% of eggs hatched, and 65% of hatched birds survived to leave the nest (Longcore and Jones 1969). In Maryland, Whitcomb et al. (1981) reported that thrushes produced two broods per year and had a reproductive success of 7.60. In Pennsylvania, nesting failure was caused by predation more than 95% of the time (Hoover 1992); 78% of nest depredation was attributed to small mammal/snake/avian nest predators and 22% to large mammal nest predators. Much work on reproductive success in wood thrushes has also been done by Hoover (1992) in relation to forest fragmentation.

Long-term population dynamics in a 15-ha woodlot were studied in Delaware by Roth and Johnson (1993). A sustained episode of reduced production per female and of an increased percentage of adults failing to produce any young coincided with a 4% annual decline in abundance between 1978 and 1987. When failure rate later dropped, return rate and abundance subsequently increased. Roth and Johnson (1993) concluded that a period of elevated, predation-caused failure prompted greater emigration by an ever-younger, less-site-faithful population.

Ecology Comments:
POPULATION DENSITY: Published information on densities from breeding bird censuses in the southeastern U.S. between 1947 and 1979 were summarized by Hamel et al (1982): mean (standard error) density is listed as 14.2 (1.0) pairs per 40 ha with a density range of 1-41 pairs per 40 ha. In bottomland

hardwood forests along the Roanoke River in eastern North Carolina, R. Sallabanks (unpubl. data) found thrushes to be most abundant in wide patches of levee forest where an average 1.14 singing males were detected per unlimited radius 10-min point count. Holmes and Sherry (1988) reported a mean (standard error) abundance in Hubbard Brook Experimental Forest, New Hampshire, of 4.64 (2.83) adult birds per 10 ha over the period 1969-1986 over which time the population showed a highly significant decline at Hubbard Brook (a similar pattern to that reflected for the state of New Hampshire population by BBS data). Whitcomb et al.(1981) found 125 males per sq km in an area in Maryland.

TERRITORIES: Freemark and Merriam (1986) listed the territory size as less than 2 ha. In wintering areas in southern Veracruz, some individuals were territorial and highly sedentary, often remained within 150 m of capture point for entire winter; other birds wandered (Rappole et al. 1989, Winker et al. 1990). Some birds return to same wintering areas in successive years (Rappole et al. 1989).

Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Arrives in wintering areas in Middle America in October (Rappole et al. 1989); males first arrive in the southern U.S. in March-April (Terres 1980). Migrates through Costa Rica late September to mid-November and March-April (Stiles and Skutch 1989).

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Shrubland/chaparral, Suburban/orchard, Woodland - Hardwood, Woodland - Mixed

Habitat Comments:
BREEDING: deciduous or mixed forests with a dense tree canopy and a fairly well-developed deciduous understory, especially where moist (Bertin 1977, Roth 1987, Roth et al. 1996). Bottomlands and other rich hardwood forests are prime habitats. Also frequents pine forests with a deciduous understory and well-wooded residential areas (Hamel et al. 1982). Thickets and early successional woodland generally do not provide suitable habitat (Bertin 1977). Bertin (1977) found wood thrushes to require one or more trees at least 12 m tall, possibly for song perches, whereas Morse (1971) reported nesting in stands of young white pine with a canopy under 9 m in height. Nests usually are placed in a crotch or are saddled on a branch of a shrub, sapling, or large tree,

NON-BREEDING: In migration and winter, habitats include forest and woodland of various types from humid lowland to arid or humid montane forest, also scrub and thickets; primarily undisturbed to moderately disturbed wet primary forest; may wander into riparian forest and various stages of second growth (Rappole et al. 1989, Winker et al. 1990). Were recorded exclusively in forest in Atlantic lowlands of Costa Rica (Hagan and Johnston 1992). Winker et al. (1990) studied within-forest preferences of birds wintering in southern Veracruz and found that areas with gaps were preferred in this lowland rainforest; areas with heavy ground cover were also favored.

Adult Food Habits: Frugivore, Invertivore

Immature Food Habits: Frugivore, Invertivore

Food Comments: Eats insects and other invertebrates (e.g., snails), and small fruits; forages mainly on or near ground, sometimes in tree foliage (Terres 1980).

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 20 centimeters
Weight: 47 grams

Global Status: G5
Global Status Last Reviewed: 23Aug2000
Global Status Last Changed: 23Aug2000
Rounded Global Status: G5 - Secure
Reasons: Large range in eastern North America; many occurrences; decreasing population trend but still common in many areas; threatened by forest fragmentation and resulting increases in brood parasitism by cowbirds and nest predation.

National Status: N5B
State Status: Delaware (S5B)

Stewardship Overview: Common throughout much of the eastern U.S. and most often found in deciduous or mixed forests with a fairly well-developed deciduous understory, especially where moist. Closed canopies are required. BBS data show this species to be most common in West Virginia, New Hampshire, and Maryland, with the Cumberland Plateau of the Appalachian Mountains being the most heavily populated Physiographic Region. Analyses of population trends show declines on regional and global scales. These declines are apparently due to loss and fragmentation of habitat, which has caused increased rates of nest predation and brood parasitism. In some areas of the Midwest, for example, thrushes are producing more cowbirds than thrushes, and avian nest predators such as grackles and crows are a serious threat. Tropical deforestation may also be a major threat to this species. Management recommendations are that forests be left unfragmented and low-volume selective cutting be used as an alternative to clear cutting where possible. Management needs include determination of key vegetation types associated with nesting success and a better understanding of minimum patch size requirements for source populations. Long-term monitoring of breeding productivity should be conducted wherever possible.

Restoration Potential: Although numbers are declining, there is no need of restoration in any state. However, should the need arise, restoration should be possible if fragmentation of habitat and edge effects can be minimized; this in turn should minimize the impact of cowbirds and nest predators.
Preserve Selection & Design Considerations: The key habitat requirement is a moist woodland understory of deciduous shrubs or saplings; bottomland and other rich hardwood forests are prime examples. Pine forests with a deciduous understory are also used, as are well-wooded residential areas. These habitat types should be a part of any preserve design considerations. As important as habitat type is preserve size. Nest predation and cowbird parasitism rates are higher in small woodlots and along the edges of larger tracts than in the interior of large tracts. Data from fragmented forests in the Midwest show that reproductive rates probably were well below levels necessary to compensate for adult mortality (Robinson

and Wilcove 1994). Fragmented forests may therefore be population sinks with populations sustained by immigration from larger, unfragmented forest tracts. These data emphasize the importance of protecting large, unfragmented forests for breeding habitat.

Research on the effects of forest patch size on nesting success has direct implications for preserve design considerations. Hoover (1992) studied thrushes during 1990 and 1991 on 11 tracts of forest ranging in size from 9.2 ha to greater than 500 ha. Nesting success was significantly different between small and large forests (43% and 76%, respectively). Nest survival from 1990-1991 was positively correlated with forest area, forest core area, and percent forest within a 2-km radius of each study site. Nest depredation was significantly different between small and large forests (56% and 19%, respectively) and was the primary cause of nesting failure. Visitation by mammalian nest predators to scent-sign-posts was significantly different between small and large forests (41% and 14%, respectively), and relative abundance of avian nest predators was significantly higher on the small forests than on the large. Brood parasitism by cowbirds was also significantly different between small and large forests (13% and 4%, respectively) although had little influence on nesting success. Interestingly, Hoover (1992) found thrushes to be common on smaller tracts of forest, but that such birds had lower reproductive success because of high rates of nest depredation.

Large areas of forest are most favorable for breeding, though minimum patch size requirements are unclear. In Pennsylvania, nesting success was 86% in contiguous forest (> 10,000 ha), 72% in forest fragments larger than 100 ha, and 43% in small fragments of less than 80 ha; these differences were related to increased predation in the smaller forest tracts; cowbird parasitism had little influence on nesting success (Hoover et al. 1995). Whitcomb et al. (1981) reported that thrushes were present in small forest fragments (1-14 ha), but were almost twice as common if woodlots were larger than 70 ha. Thrushes were found by Galli et al. (1976) and Lynch (1987) to be more abundant in larger forest patches compared with smaller ones. In general, it appears that forest patches exceeding 100 ha are best suited for successful nesting because rates of nest predation and sometimes cowbird brood parasitism are lower. Thrushes require only small territories (< 1 ha) and seem to be able to maintain stable populations on small, isolated forest fragments in some cases (e.g., a 15-ha woodlot (Roth and Johnson 1993)). Some woodlots as small as 5 ha may be acceptable (Pinkowski 1991).

These results warn of the dangers of assuming that small fragments are acceptable just because they contain many birds; instead, we must determine reproductive success in addition to abundance relationships before we make accurate conclusions about habitat quality. Hoover (1992) concluded that to reverse decreasing population trends, land-use practices that maximize forest area and forest core area are needed.

Management Requirements: The effects of silvicultural practices such as clearcutting and selective logging on migratory songbirds may depend upon the landscape context (Robinson and Wilcove 1994). Preliminary evidence from the fragmented Shawnee National Forest of southern Illinois suggests that selective logging can have relatively little impact on thrushes. Robinson and Wilcove (1994) tentatively proposed that low-volume selective logging be used as an alternative to clearcutting. Logging roads should be closed and revegetated soon after harvest, and rotation times should be lengthened to permit regeneration of large, old trees.

The importance of protecting large, unfragmented forests for breeding habitat cannot be overstated.

Where possible, forest preserves should be on the order of 10,000+ ha because cowbirds routinely commute up to seven kilometers between feeding and breeding sites. Fragmented forests might benefit from consolidation of ownership and forest regrowth within the largest tracts. Where necessary, cowbird control might be tried within the core of the largest tracts.

Vegetation patterns associated with successful reproduction need to be identified; then appropriate management plans can be devised. Thrushes are classified as closed-canopy obligate species and will tolerate uneven-age management forest stands (Crawford et al. 1981); single-tree selection (removal of mature trees as scattered individuals throughout the stand) and thinning understory trees that compete for root space will create favorable conditions for this species. Light diameter-limit cutting that removes only the best trees from the stand would be tolerated. Any intermediate or harvest cutting that opens the canopy will probably be detrimental.

Monitoring Requirements: Annual surveys of suitable habitat and known populations using point count censusing techniques are probably the best way to monitor this species. Long-term studies are obviously preferred. Studies should also monitor breeding productivity to provide critical information of factors affecting population recruitment and dynamics; it is imperative that we determine why reproductive success may be low, as well as why numbers of birds may be low. See Yahner and Ross (1995) for information on the use of taped-playback songs in transect surveys and nest searches (June is the best month).

Management Research Needs: Minimum area requirements for source populations seem to be the least understood aspect of management. Vegetation characteristics associated with nest-site selection and reproductive success also need to be quantified. Also, we need to understand better the role of tropical deforestation in the decline of regional thrush populations; habitat fragmentation on temperate breeding grounds cannot alone explain these declines.

Additional topics: Other research has concerned habitat selection and competition (Noon 1981), homing behavior (Able et al. 1984), taxonomy (Winker and Rappole 1988), mass variation in breeding birds (Johnson et al. 1990), and several aspects of wintering populations in southern Veracruz (Rappole et al. 1989, Winker et al. 1990).

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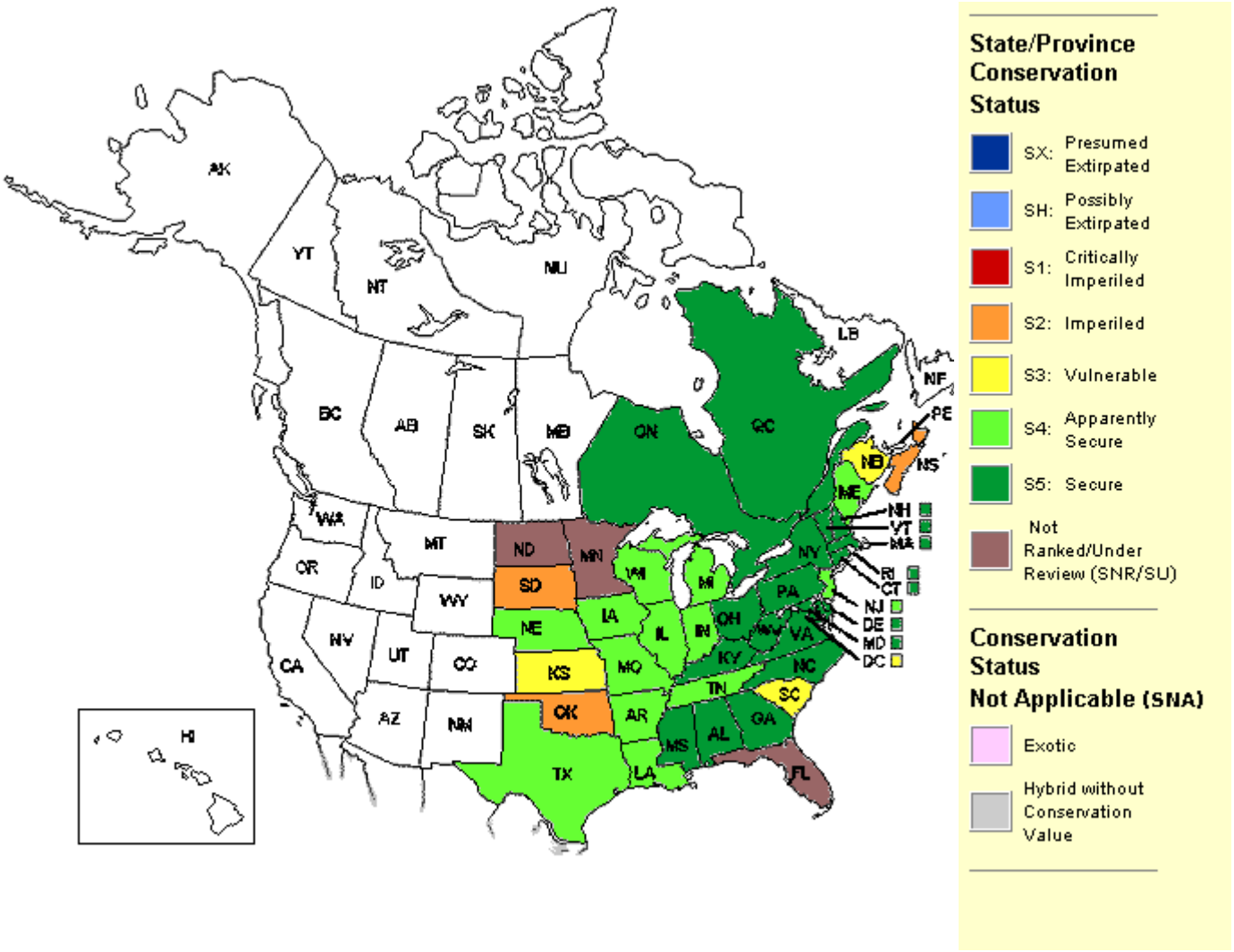
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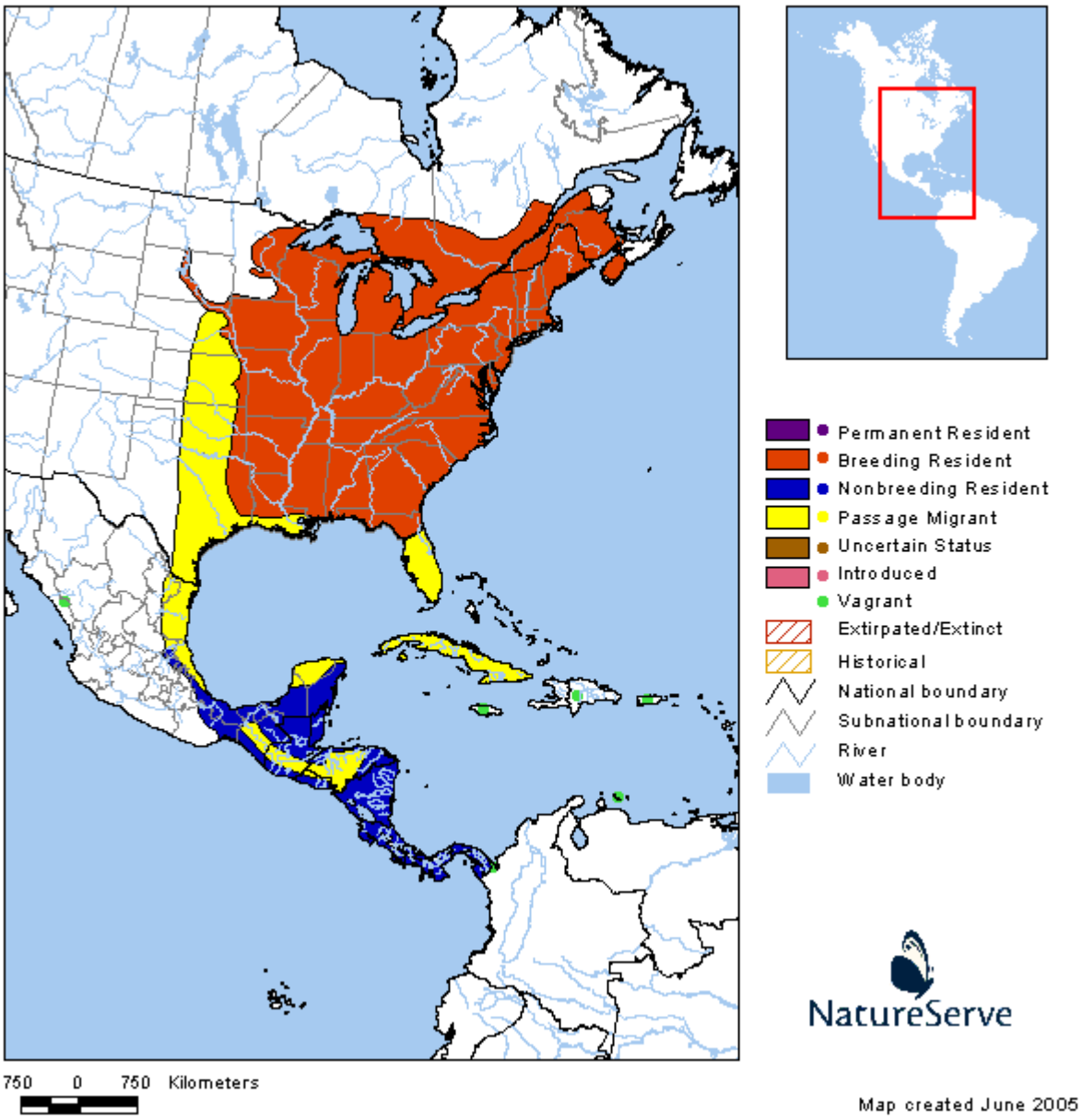
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Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Melospiza georgiana - (Latham, 1790)
Swamp Sparrow

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Emberizidae	Melospiza

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Melospiza georgiana
Taxonomic Comments: Inland and coastal populations along mid-Atlantic coast show marked morphological and life history differences; M. G. NIGRESCENS regarded as a well-marked subspecies by Greenberg and Droege (1990). Greenberg et al. (1998) examined mitochondrial DNA differentiation between NIGRESCENS, GEORGIANA, and EPICRYPTA and found low levels of genetic variation and no evidence of geographic structure.

Reproduction Comments: Clutch size 2-6 (usually 4-5 in most areas). Usually 2 broods per year. Incubation 12-15 days, by female. Young leave nest at 9-13 days.

Non-Migrant: N

Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Arrives in nesting areas in Canada and northern U.S. usually in March-April (Terres 1980); subspecies NIGRESCENS arrives in coastal mid-Atlantic breeding areas in mid-May, apparently departs by September-October (Greenberg and Droege 1990).

Estuarine Habitat(s): Herbaceous wetland

Palustrine Habitat(s): Bog/fen, FORESTED WETLAND, HERBACEOUS WETLAND, Riparian, SCRUB-SHRUB WETLAND

Terrestrial Habitat(s): Grassland/herbaceous, Old field, Shrubland/chaparral

Habitat Comments:
BREEDING: Marshes, wet brushy fields, meadows, lakeshores, stream borders, swamps, pine barrens shrub-sedge bogs; also brackish marshes along mid-Atlantic coast (Greenberg and Droege 1990). Nests in tussock of grass, sedge, or in low bush, commonly over water.

NON-BREEDING: In migration and winter also in weedy fields, brush, thickets, scrub, and forest edge (AOU 1998).
Adult Food Habits: Granivore, Invertivore
Immature Food Habits: Granivore, Invertivore
Food Comments: Eats insects and seeds; often forages in shallow water (Terres 1980).
Adult Phenology: Diurnal
Immature Phenology: Diurnal
Length: 15 centimeters
Weight: 17 grams

Global Status: G5
Global Status Last Reviewed: 04Dec1996
Global Status Last Changed: 04Dec1996
Rounded Global Status: G5 - Secure

National Status: N5B,N5N
State Status: Delaware (S3B,S4N)

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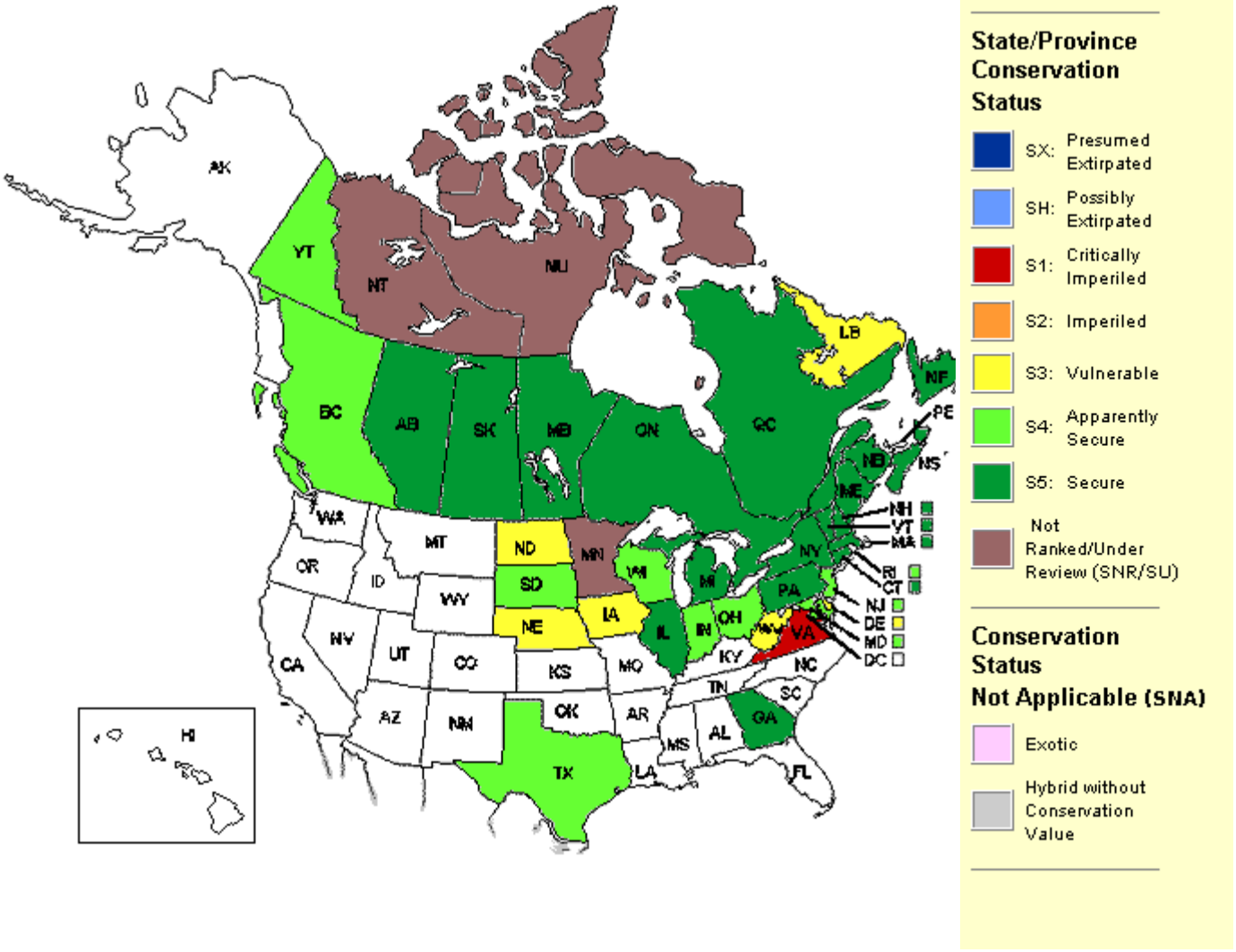
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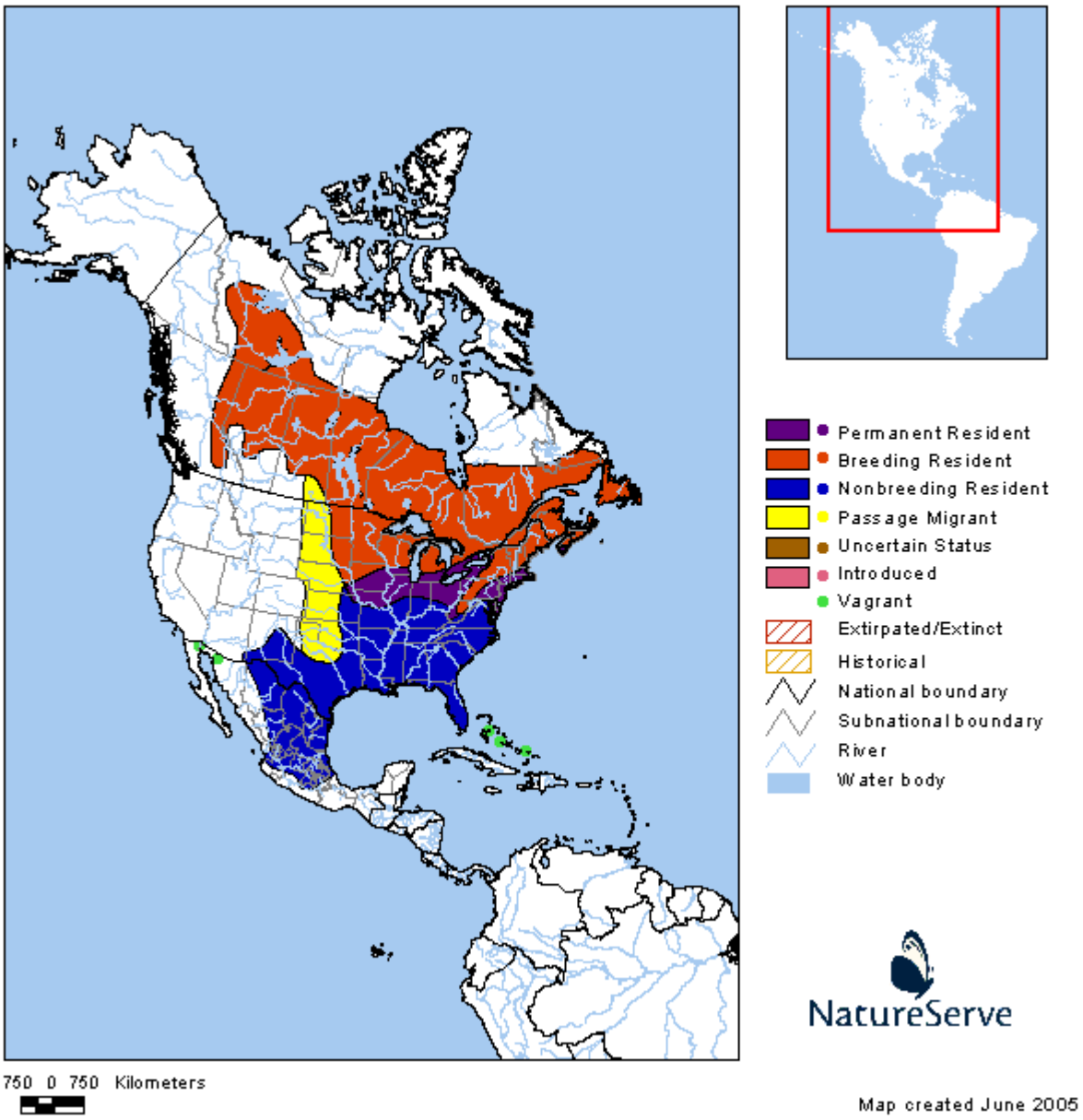
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River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Phalacrocorax auritus - (Lesson, 1831)
Double-Crested Cormorant

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Pelecaniformes	Phalacrocoracidae	Phalacrocorax

Genus Size: D - Medium to large genus (21+ species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Phalacrocorax auritus
Taxonomic Comments: See Siegel-Causey (1988) for analysis of relationships within family. Siegel-Causey (1988) proposed removing this species from the genus PHALACROCORAX and placing it in the

genus HYPOLEUCUS; DeBenedictus (1989) concluded that the taxonomic ranks of many groups recognized by Siegel-Causey (1988) are inflated and inconsistent with other taxonomic data.

Reproduction Comments: Time of nesting varies geographically, with local variations, and among different years a particular colony. Nesting begins in winter in Florida, as late as early June in southern Alaska. Clutch size usually one to seven (average typically three or four). Incubation 24-33 days (average around 28-30), by both sexes in turn. Hatching success was 54-75% in three studies. Survival from hatching to fledging was 72-95% in two studies. First flight to water at about 35-42 days. Independent at about 9-10 weeks. Usually first breeds at three years, sometimes at two years, rarely at one year. Renesting following loss of clutch is fairly common. Nest in relatively dense colonies; nests only 0.6 - 2.0 meters apart (Hatch and Weseloh 1999). New colonies may be abandoned within a few years, but once well established, likely to persist (Hatch and Weseloh 1999). See Johnsgard (1993) for further information.

Ecology Comments:
Typically forages within about 20 km of roost site (Johnsgard 1993). No available information on interannual fidelity to colony; median distance of breeding birds to their natal site was < 25 kilometres (Dolbeer 1991). Increased sea surface temperatures, such as those associated with El Nino events, were correlated with decreases in nesting populations in Washington (Wilson 1991). Vigorously defends eggs and young against avian predators (Ehrlich et al. 1992), though large gulls, crows, and ravens are significant predators on eggs and young in some areas.

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: Northern coastal and especially interior populations migrate southward for nonbreeding season; migratory tendency is stronger on east coast than on west coast. Usually follows river valleys, coastlines, and water courses. Migrates day or night (Palmer 1962). East of the Rockies, migrates southward from northern latitudes in October-November, northward in April-May; breeders from the central and eastern parts of Canada and the northern U.S. winter mainly in the southern U.S. between Texas and Florida, with considerable overlap of different breeding populations on the wintering grounds; there is little intermixing of birds from east and west of the Rockies (Dolbeer 1991).

Marine Habitat(s): Near shore

Estuarine Habitat(s): Bay/sound, Lagoon, River mouth/tidal river, Tidal flat/shore

Riverine Habitat(s): BIG RIVER, Low gradient

Lacustrine Habitat(s): Deep water

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Bare rock/talus/scree, Cliff

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Lakes, ponds, rivers, lagoons, swamps, coastal bays, marine islands, and seacoasts; usually within sight of land. Nests on the ground or in trees in freshwater situations, and on coastal cliffs (usually high sloping areas with good visibility). See Spendelow and Patton (1988) for further details on nesting sites in different geographic areas.

Adult Food Habits: Piscivore

Immature Food Habits: Piscivore

Food Comments: Feeds opportunistically on fishes (usually less than 13 cm long); dives from surface of water; usually feeds in water < 15 m deep. Accused of reducing sport fish populations in New York, but this contention has not been documented (Carroll 1988). Eats mostly schooling fishes (in marine waters, mainly slow-moving species of bottom and mid-water), sometimes aquatic invertebrates and rarely small vertebrates other than fishes. Sometimes forages in compact flocks.

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Colonial Breeder: Y
Length: 81 centimeters
Weight: 1818 grams

Global Status: G5
Global Status Last Reviewed: 20Nov1996
Global Status Last Changed: 20Nov1996
Rounded Global Status: G5 - Secure
Reasons: Large breeding range in North America; rapidly increasing populations

National Status: N5B,N5N
State Status: Delaware (S1B)

Global Abundance: 100,000 to >1,000,000 individuals

Global Abundance Comments: Widespread and increasing. In 1994, estimated at least 372,000 nesting pairs throughout North America (Tyson et al. 1997). Relative abundance recorded on North American Breeding Bird Survey (BBS) survey-wide 1966-1996 was 0.76 birds per route. Highest relative abundance recorded in Minnesota (2.64 birds per route; Sauer et al. 1997). In winter, survey-wide Christmas Bird Count (CBC) shows 11.96 birds per 100 survey hours, 1959-1988. Highest CBC relative abundance recorded in North Carolina during the same period (170.64 birds per 100 survey hours; Sauer et al. 1996). High winter densities also occur in southern Florida, northern South Carolina, and along the lower Colorado River valley in the southwestern U.S. (Root 1988).

Estimated Number of Element Occurrences: > 300

Estimated Number of Element Occurrences Comments: In 1994, 852 colonies throughout North America (Tyson et al. 1997); number of defined occurrences may be somewhat lower.

Global Short Term Trend: Increasing (increase of >10%)

Global Short Term Trend Comments: From 1973 to 1993, Great Lakes population increased over 300-fold to over 38,000 pairs; a historic high (Weseloh and Collier 1999). Along St. Lawrence River, have increased from 12,000 pairs in 1979 to 22,000 pairs in 1990 (QBW 1999). Now increasing almost everywhere. Although BBS and other roadside surveys are not the most appropriate census method for colonial-nesting water birds trend data still provides useful information. Survey-wide increase according to BBS 1966-1996 (6.8 percent annual change; P = 0.00; n = 327). Greatest percent increase in central region (22.7 percent annual change; P = 0.00; n = 77) for same period. No significant decreases for periods 1966-1999, 1966-1979, or 1980-1996 (Sauer et al. 1997). In winter, CBC 1959-1988 indicates survey-wide increase (7.3 percent annual change; P less than 0.01; n = 790; Sauer et al. 1996).
Global Long Term Trend: Increase (increase of >25%)

Global Long Term Trend Comments: Declined in the 1960s and subsequently recovered. Largest decline in the Great Lakes population largely due to effects of DDT. Great Lakes population decreased by 86 percent from approximately 900 in the early 1950s to a mere 125 in 1973. Disappeared as a nesting bird on Lakes Michigan and Superior and only about ten pairs remained on Lake Ontario (Weseloh and Collier 1999).

Global Protection: Many to very many (13 to >40) occurrences appropriately protected and managed

Global Protection Comments: Likely protected by numerous managed areas given the widespread range. Placed on the state lists of threatened and endangered wildlife in Wisconsin and Illinois. In 1972, added to the list of species protected by the 1918 Migratory Bird Treaty Act (USFWS 1999a).

Degree of Threat: C

Threats: PERSECUTION: Has long been hunted for both eggs and meat. Persecuted because thought to compete with fishermen. Hunted illegally; in June of 1998, over 800 birds were shot in eastern Lake Ontario and 20 were shot in 1994 on Four Brothers Island, New York. Also hunted legally; in Quebec, Canada, a government-sponsored control program involves shooting adults, destroying nests, and spraying eggs with an oily substance that asphyxiates the embryos (QBW 1999). U.S. Fish and Wildlife Service permits the lethal take of cormorants, without a permit, on catfish and bait fish farms in 12 southeastern states and Minnesota, where economic impacts have been well-documented and non-lethal control has proven ineffective (USFWS 1999a). PESTICIDES: Contamination by organochlorine pesticides greatly reduced reproductive success during the 1950s and 1960s significantly reducing populations along the Great Lakes and in other areas (Anderson et al. 1969, cited in INRIN 1999; Weseloh et al. 1983, cited in USFWS 1999b). Eggshell thinning due to exposure to DDE, DDT, and PCB's widely reported during this period (INRIN 1999, USFWS 1999a). By the early 1970s, eggshells from the Great Lakes region were nearly 30% thinner than normal (Weseloh and Collier 1999). Contamination caused reproductive failure, and chicks that hatched sometimes had crossed bills, club feet, and eye and skeletal deformities (USFWS 1999a). Deformities resulting from the ingestion of PCBs have been noted in the vicinity of Green Bay,

Wisconsin (Ehrlich et al. 1992). Populations increased in New England beginning 1970 after the use of these pesticides was banned; did not increase in other areas until the 1980s (USFWS 1999b).

PREDATION: Predation of eggs and young by crows and ravens (CORVUS spp.) and gulls (LARUS spp.; INRIN 1999). Verbeek (1982) reports that crows were responsible for the destruction of 22 percent of eggs (first clutch) in British Columbia. Also, temporary food shortages may be a possible limiting factors. HABITAT: Nesting habitat may become an important limiting factor (USFWS 1999a). See also Spendelow and Patton 1988; Carroll 1988; Johnsgard 1993; Markham, 1978 COSEWIC report; Hyslop and Kennedy 1992; Chapdelaine and Brousseau 1992; Vermeer and Sealy 1984; Lensink 1984; Buckley and Buckley 1984).

Other Considerations: Considered a nuisance species by fisherman. Can feed heavily on small fish being raised commercially on minnow farms for bait, or for human consumption at fish farms or aquacultural sites. Game fish, however, appear to be minor components of the diet in Great Lakes region (Belyea et al. 1997, Bur et al. 1997, Ross and Johnson 1997). Also, in some locations within the Great Lakes basin have propensity for killing the trees in which they nest and roost and are competing with other colonial nesting water and wading birds for the same island nesting sites. There is heightened concern when this competition jeopardizes the reproductive success of rare, threatened, or endangered plant and animal species (USFWS 1999a).

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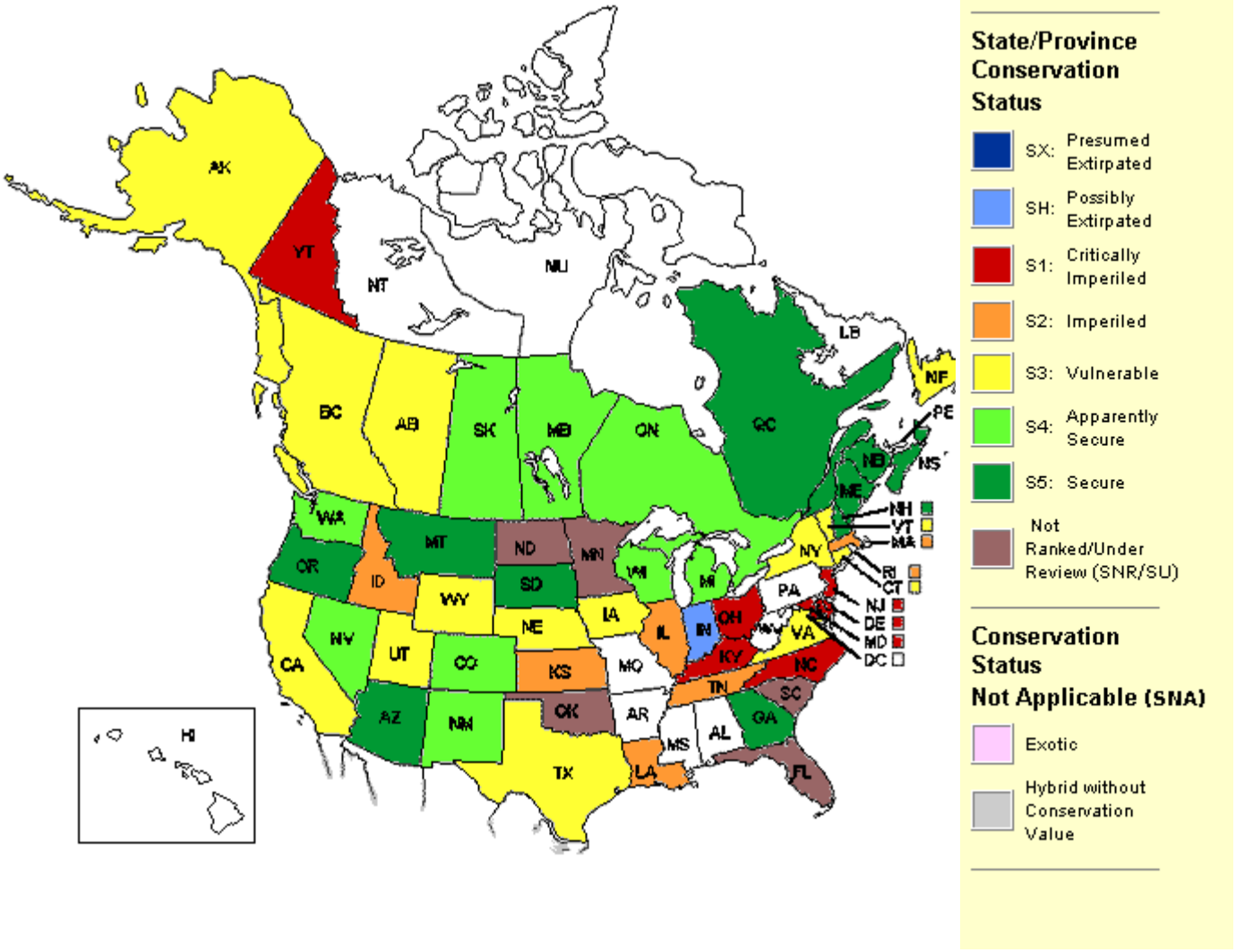
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State/Province Conservation Status
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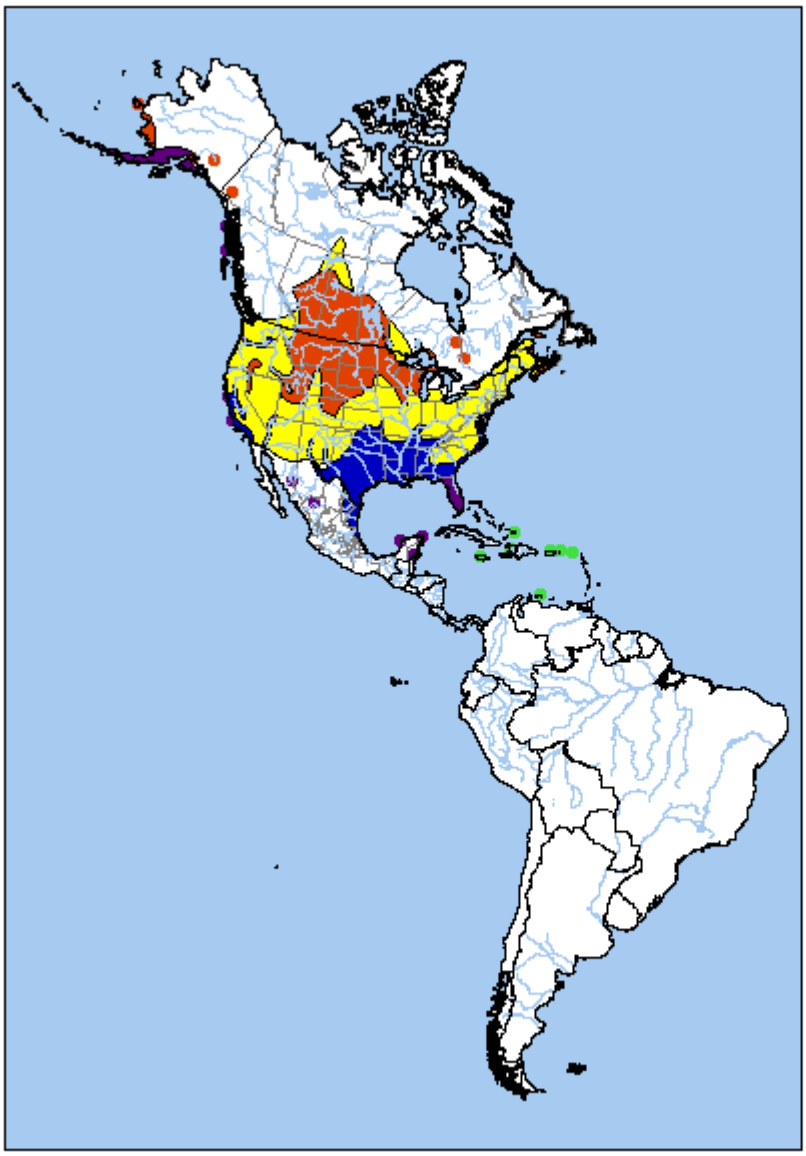

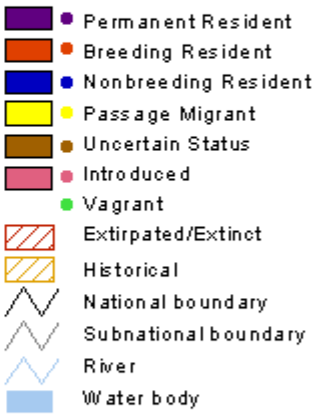

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Map created June 2005

Picoides villosus - (Linnaeus, 1766)
Hairy Woodpecker

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Piciformes	Picidae	Picoides

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Picoides villosus

General Description: A medium-sized woodpecker with (in most areas) a white back, white-spotted black wings (spotting is reduced in Rocky Mountains), a relatively large bill, white underparts, and a black head with two large white bars on each side; tail is black centrally, white on the sides; plumage that is white in most of the range is pale gray-brown in the Pacific Northwest; adult males have a red bar across the back of the head, young males have an orange- or red-streaked crown; juveniles (particularly in Maritime Provinces) have some dark barring on the bank and flanks; average length 24 cm (NGS 1983).

Diagnostic Characteristics: Differs from the downy woodpecker in larger size (average length 24 cm vs. 17 cm), larger bill (about as long as head vs. obviously shorter than head), absence of black bars or spots on outer tail feathers (downy generally has spots), and sharper call note (peek! vs. pik). Differs from

three-toed and black-backed woodpeckers in lacking dark barring on the sides (may be present on flanks of juveniles).

Reproduction Comments: Nests early April to mid-June in Maryland (see Bushman and Therres 1988). Clutch size is 3-6 (usually 4). Incubation lasts 11-12 days, by both sexes. Young leave nest at 28-30 days, then rely on parents for about 2 more weeks, may return to nest to roost.

Ecology Comments:
Female spends entire year on breeding territory, joined in late winter by male (Harrison 1979). Reported territory size 0.6-15 hectares; varies with habitat quality. In central Ontario, breeding territories averaged 2.8 hectares, range 2.4 to 3.2 hectares (Lawrence 1967).

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: N
Mobility and Migration Comments: Northernmost breeding populations partially migratory. May migrate between higher and lower elevations in mountainous regions.

Palustrine Habitat(s): FORESTED WETLAND, Riparian

Terrestrial Habitat(s): Forest - Conifer, Forest - Hardwood, Forest - Mixed, Suburban/orchard, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Special Habitat Factors: Standing snag/hollow tree

Habitat Comments: Forest, open woodland, swamps, well-wooded towns and parks, open situations with scattered trees. Most abundant in mature woods with large old trees suitable for cavity nesting; also common in medium-aged forests; prefers woods with a dense canopy (Bushman and Therres 1988). Uses tree cavities for roosting and winter cover; may excavate new cavities in fall to be used for roosting (Sousa 1987). Sleeps singly in holes usually carved by males (Stiles and Skutch 1989). In the eastern U.S., uses forest areas of 2-4 ha or larger, though a much larger area (maybe 12 ha) may be needed to support a viable breeding population; in Iowa the minimum width of riparian forest necessary to support a breeding population was 40 m (Sousa 1987). Overall, appears to be minimally impacted by forest fragmentation, though a few studies have reported a decline in numbers as forest patch size decreases; the presence of suitable cavity trees is a more important consideration (see Bushman and Therres 1988).

Nests in hole dug mostly by male in live or dead tree or stub, 1.5-18 m (average 9 m) above ground. In most areas, favors dead or dying parts of live trees, especially where fungal heart rot has softened the heartwood. Snag (25 cm or more in DBH) density of 5/ha assumed optimal for reproduction (but may not be adequate for foraging) (Sousa 1987). Nest tree DBH minimally 20 cm; averaged 27-28 cm in New England, 38 cm in Colorado, 41 cm in Virginia, 44 cm in California, and 92 cm in Oregon (Sousa 1987). See Sousa (1987) for fairly detailed summary of nesting habitat characteristics in different regions. Usually excavates new nest hole each year. May nest in utility pole or bird box.

Adult Food Habits: Granivore, Invertivore

Immature Food Habits: Granivore, Invertivore

Food Comments: Eats mainly insects (beetles, ants, caterpillars), especially boring larvae, obtained from bark or wood of trunks and branches of trees or from soft shrubs or old giant thistle stalks; also eats other invertebrates and some fruits and nuts (Terres 1980). May concentrate feeding in areas of insect outbreaks. Sometimes feeds on sap from wells drilled in trees by sapsuckers. Seeds may be important food in winter. Uses various foraging substrates, ranging from dead and live trees to downed wood and ground; see Sousa (1987) for details.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 24 centimeters
Weight: 70 grams

Global Status: G5
Global Status Last Reviewed: 02Dec1996
Global Status Last Changed: 02Dec1996
Rounded Global Status: G5 - Secure
Reasons: Large range and common in many areas; no evidence of large-scale declines

National Status: N5
State Status: Delaware (S3)

Global Abundance: 10,000 to >1,000,000 individuals

Estimated Number of Element Occurrences: 81 to >300

Global Short Term Trend: Stable (unchanged or within +/- 10% fluctuation in population, range, area occupied, and/or number or condition of occurrences)

Global Short Term Trend Comments: Reportedly declining (in the 1980s) in several parts of the range (Ehrlich et al. 1992), though these declines probably were only local.

Degree of Threat: D

Threats: Local declines may result from usurpation of nest cavities by house sparrows or starlings.

Management Requirements: Any timber practices that remove all decayed trees are detrimental. Forest management should allow for the continued availability of cavity trees.

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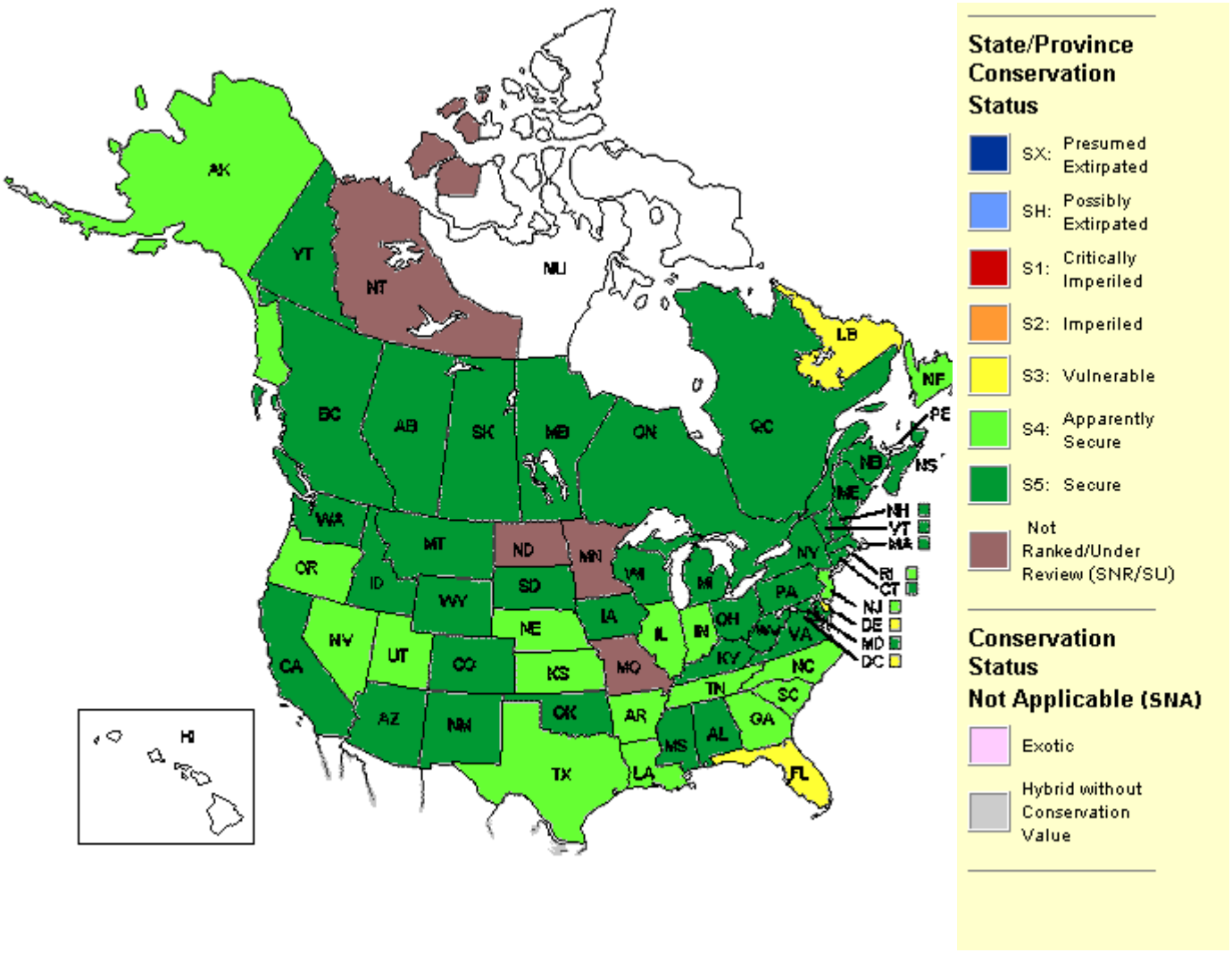

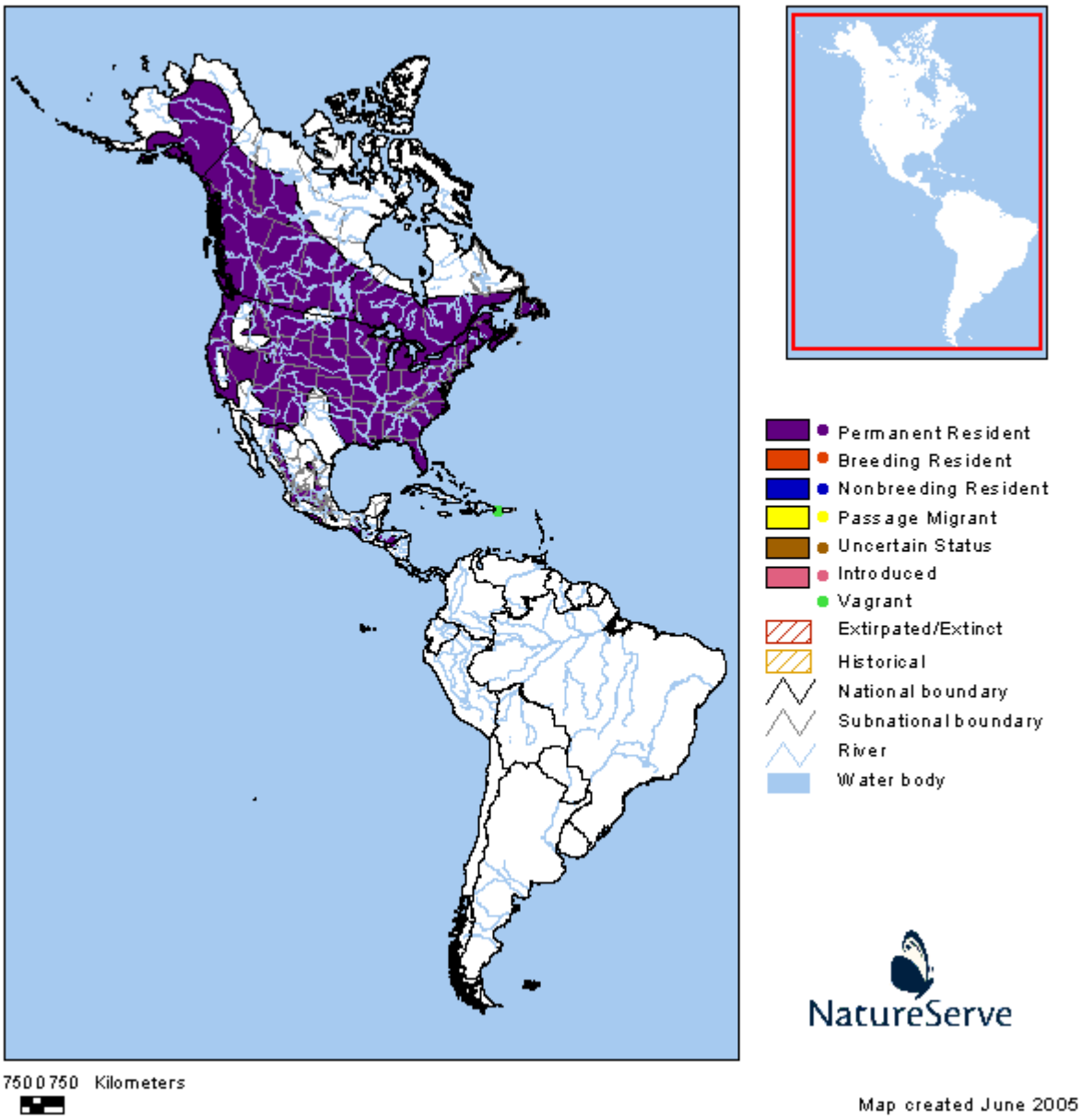
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
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Extirpated/Extinct
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National boundary
Subnational boundary
River
Water body
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750 0 750 Kilometers
Map created June 2005

Plegadis falcinellus - (Linnaeus, 1766)
Glossy Ibis

© Dennis Donohue

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Ciconiiformes	Threskiornithidae	Plegadis

Genus Size: B - Very small genus (2-5 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Plegadis falcinellus
Taxonomic Comments: Sometimes considered conspecific with P. CHIHI, but sympatric breeding occurs in Louisiana (AOU 1983, 1998).

General Description: A medium-sized wading bird with a long, slender, decurved bill, long legs, and a long neck (extended in flight); adult plumage is basically all dark (chestnut, partially glossed with green and purple during the breeding season); immatures and winter adults have some pale streaking or spotting on the head and neck (elsewhere all dark); average length 58 cm, wingspan 91 cm (NGS 1983).

Diagnostic Characteristics: Breeding adult differs from breeding adult white-faced ibis by olive-brown (vs. reddish) bill, brown (vs. red) eyes, gray-green legs with red joints (vs. all-red legs), and lack of a white feathered area adjacent to facial skin; also, in glossy ibis, pale edge of gray facial skin does not extend behind eye or under chin (white-faced ibis adult has white behind eye and under chin). Winter adult differs from winter adult white-faced ibis in usually having a pale line between the eye and bill (line absent in white-faced). In first fall plaumage, indistinguishable from immature white-faced ibis (NGS 1983).

Reproduction Comments: Clutch size usually is 3-4 (3 in south). Incubation, by both sexes (male during part of daylight period), lasts about 21 days. Young are tended by both parents, fly well and get own food at 4-6 weeks. Nests in small colonies; most colonies include less than 100 breeders (but up to about 1800) (Spendelow and Patton 1988).

Ecology Comments:
Nonbreeding: solitary or in small groups when feeding (Stiles and Skutch 1989).

Non-Migrant: Y
Locally Migrant: Y
Long Distance Migrant: Y

Estuarine Habitat(s): Herbaceous wetland, Lagoon, Scrub-shrub wetland, Tidal flat/shore

Lacustrine Habitat(s): Shallow water

Palustrine Habitat(s): FORESTED WETLAND, HERBACEOUS WETLAND, Riparian, SCRUB-SHRUB WETLAND

Habitat Comments: Marshes, swamps, lagoons, pond margins, lakes, flooded pastures; fresh, brackish, and salt water. Reported as mainly in freshwater habitats on the Atlantic coast of Florida, more common in saltwater habitats in Louisiana (Spendelow and Patton 1988). Nests usually with herons or other water birds, on the ground in a marsh or in small trees or bushes near water (e.g., in BACCHARIS, IVA, and MYRICA along the U.S. Atlantic coast). See Spendelow and Patton (1988) for further details on nesting habitat in different regions.

Adult Food Habits: Carnivore, Invertivore

Immature Food Habits: Carnivore, Invertivore

Food Comments: Eats crayfishes, insects, water snakes, and other small aquatic animals (Palmer 1962). Probes/gleans in soft mud and shallow water. Young are fed by regurgitation.

Adult Phenology: Crepuscular, Diurnal

Immature Phenology: Crepuscular, Diurnal

Colonial Breeder: Y

Length: 58 centimeters
Weight: 506 grams

Global Status: G5
Global Status Last Reviewed: 20Nov1996
Global Status Last Changed: 20Nov1996
Rounded Global Status: G5 - Secure
Reasons: Still common in portions of large range. Population trend is unknown for many regions.

National Status: N4B,N4N
State Status: Delaware (S1B)

Global Short Term Trend Comments: Population increases in the south-central U.S. may be related to favorable foraging opportunities afforded by expanding crayfish aquaculture (Fleury and Sherry 1995).
Threats: Threats include development and disturbance of nesting habitat; storms and other natural processes sometimes have adverse effects (Byrd and Johnston 1991).

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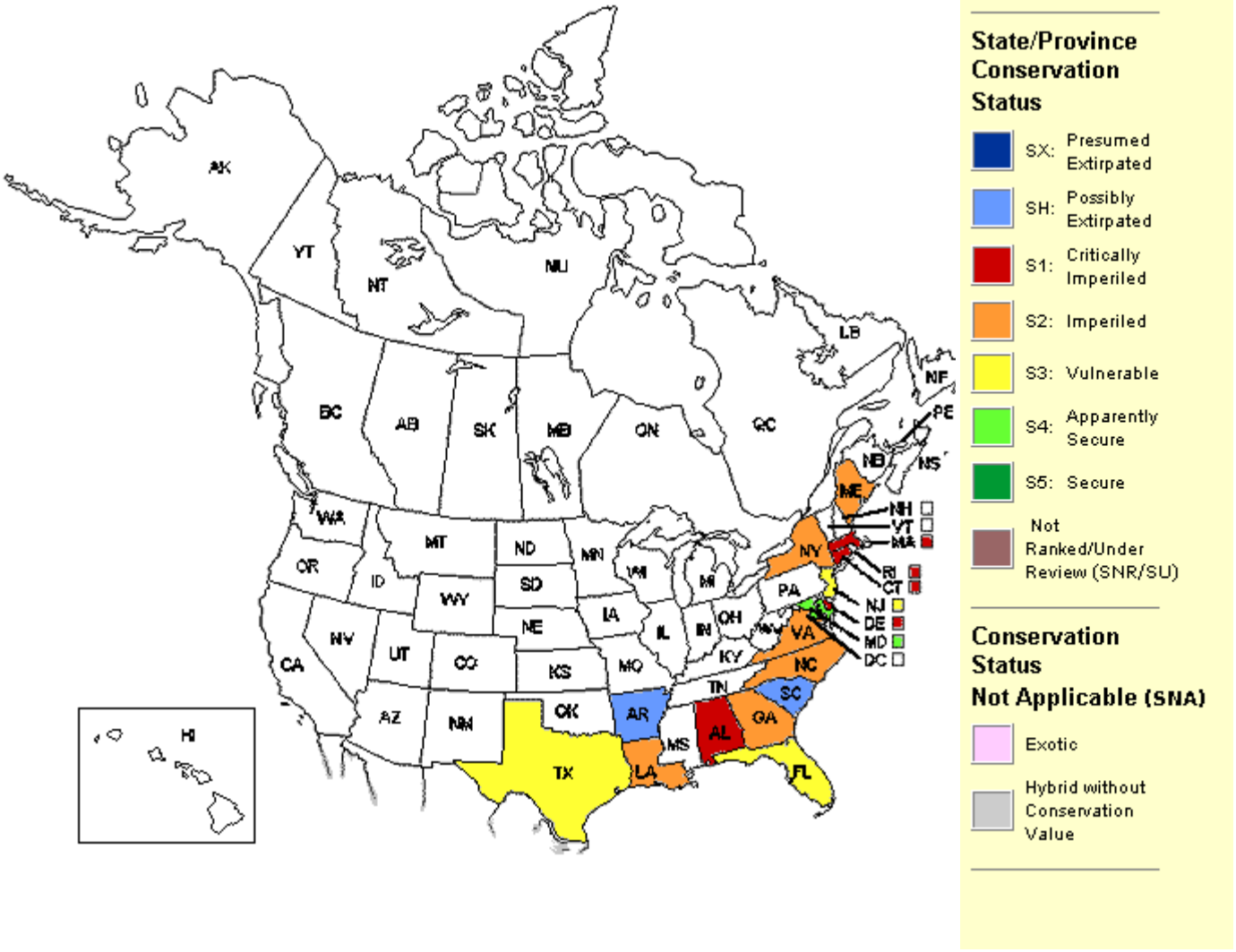
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State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
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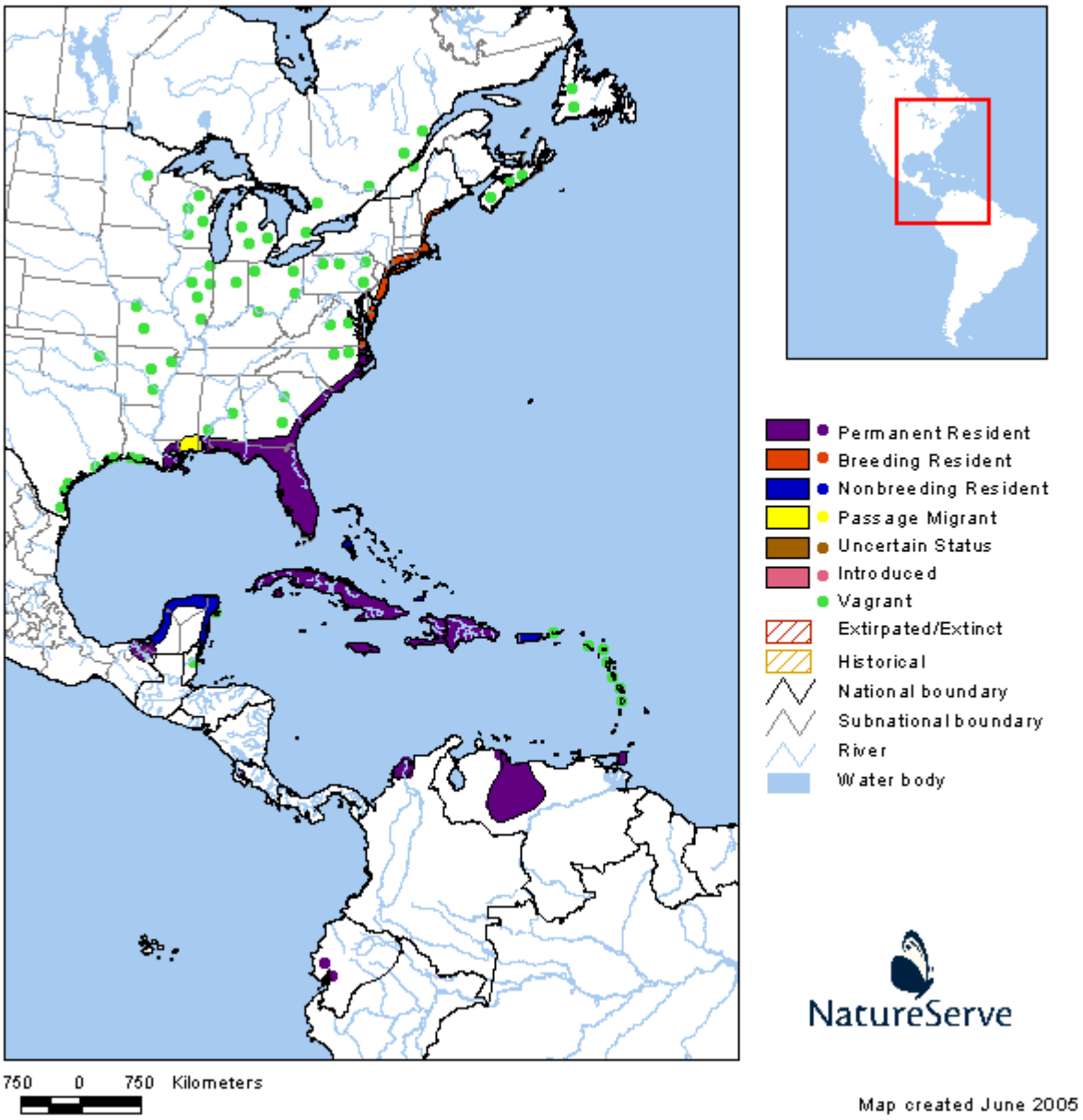
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Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Riparia riparia - (Linnaeus, 1758)
Bank Swallow

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Hirundinidae	Riparia

Genus Size: B - Very small genus (2-5 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Riparia riparia
Taxonomic Comments: See Sheldon and Winkler (1993) for information on intergeneric phylogenetic relationships of Hirundininae based on DNA-DNA hybridization.

Reproduction Comments: Clutch size is 2-8 (usually 4-5). Incubation, by both sexes, lasts 12-16 days (Terres 1980). Young are tended by both sexes, leave nest when 18-22 days old, return to burrow for a few days after first flight, remain dependent on parents for about 5 days after fledging. Some birds have two broods per year in some areas (not in north). Colony size varies; largest colonies often are in artificial sites; colonies may reach at least several hundred pairs.

Ecology Comments:
Most foraging flights within 0.8 kilometers of colony (Stoner and Stoner 1941).

May form flocks of 100s or 1000s prior to fall migration. Inclement weather and resulting scarcity of food may be important factors in nestling mortality in some years; erosion of nest sites and predators also sometimes destroy nests (Turner and Rose 1989). Most live for only one or a few years.

Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Migrates in large flocks northward through U.S. mostly in April (Terres 1980). In Puerto Rico, fairly common in spring, uncommon in fall (Raffaele 1983). Migrates abundantly through Costa Rica from late August or early September to early November and early March to mid-May (Stiles and Skutch 1989).

Estuarine Habitat(s): Herbaceous wetland

Riverine Habitat(s): Aerial

Lacustrine Habitat(s): Aerial

Palustrine Habitat(s): Aerial, HERBACEOUS WETLAND, Riparian

Terrestrial Habitat(s): Cropland/hedgerow, Grassland/herbaceous, Sand/dune, Savanna

Special Habitat Factors: Burrowing in or using soil

Habitat Comments: Open and partly open situations, frequently near flowing water (AOU 1983). Nests in steep sand, dirt, or gravel banks, in a burrow dug near the top of the bank, along the edge of inland water or along the coast, or in gravel pits, road embankments, etc. Both sexes construct the nest burrow. Usually digs a new burrow each year, but sometimes uses old bank swallow burrows or abandoned cavities of the belted kingfisher. Tends to return to same nesting area in successive years, though may move several kilometers away, especially if nesting was unsuccessful the previous year; yearlings often return to the natal area or nearby (Turner and Rose 1989).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Feeds primarily on flying insects (e.g., beetles, mosquitoes, winged ants, flies, moths). Catches insects in the air over fields, wetlands, water, etc. If necessary, may forage up to several kilometers from nesting area, but usually closer.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Colonial Breeder: Y

Length: 13 centimeters
Weight: 15 grams

Global Status: G5
Global Status Last Reviewed: 02Dec1996
Global Status Last Changed: 02Dec1996
Rounded Global Status: G5 - Secure

National Status: N5B
State Status: Delaware (S2)

Global Short Term Trend Comments: Recently has declined in eastern and central North America, increased in the West (Robbins et al. 1986), though the range in California has decreased by 50% since 1900 (California Department of Fish and Game 1990). Recent declines noted also in Europe (Turner and Rose 1989). Road building and quarrying may have increased available nest sites in some areas that formerly were unsuitable for breeding; distribution and abundance thus increased over previous circumstances (Turner and Rose 1989).

Threats: Decline in California has been due to human disturbance and channelization and stream bank modifications for flood control and bank stabilization (California Department of Fish and Game 1990). Riprapping of natural stream banks is the most serious threat to long-term survival in California (California Department of Fish and Game 1990). Small numbers inadvertently killed by intentional spraying of Dickcissel (SPIZA AMERICANA) roosts in Venezuela in non-breeding season (Basili and Temple 1999).

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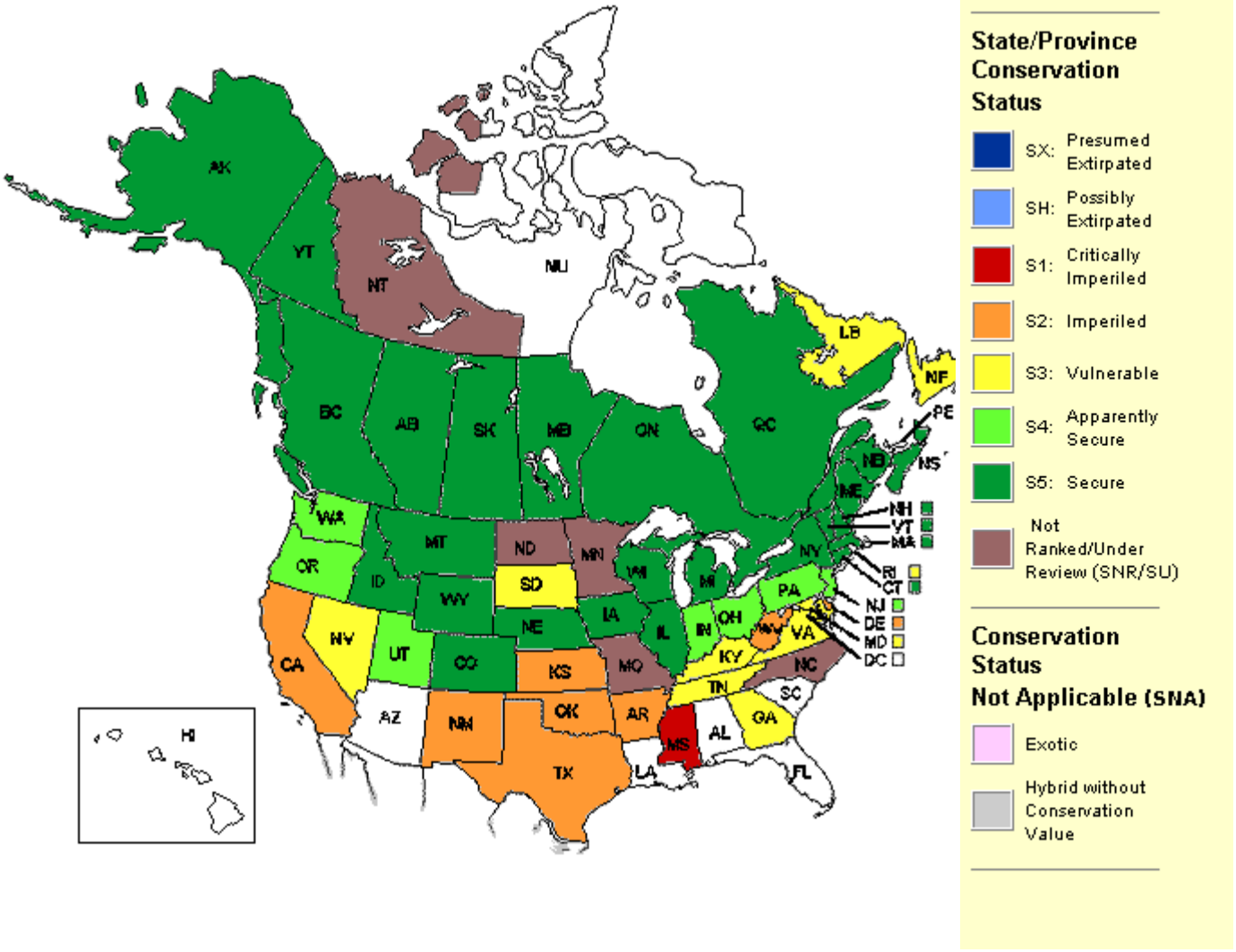
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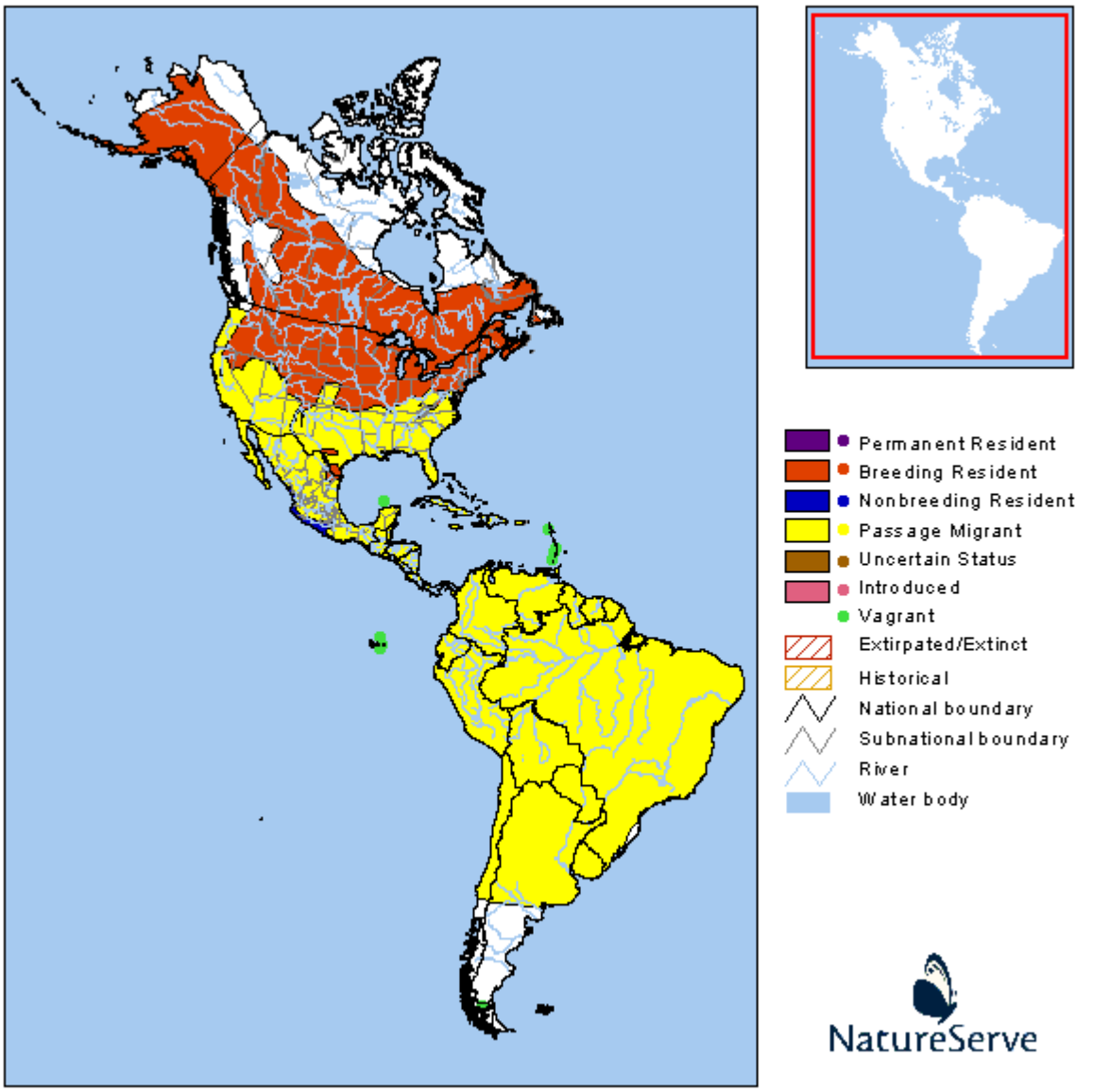
Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
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Introduced
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Historical
National boundary
Subnational boundary
River
Water body
NatureServe
7500750 Kilometers
Map created June 2005

Spizella passerina – (Bechstein, 1798)
Chipping Sparrow

© Robert Royse

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Emberizidae	Spizella

Genus Size: C - Small genus (6-20 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Spizella passerina
Taxonomic Comments: Zink and Dittmann (1993) studied restriction site variation in mtDNA across the range of S. PASSERINA and found no detectable geographic variation in haplotypes, despite the sampling of three named subspecies. They also presented a hypothesis for evolution in the genus SPIZELLA. See Dodge et al. (1995) for a comparison of phylogenies derived from two molecular data sets for the genus SPIZELLA; among other results, monophyly of SPIZELLA including the American tree sparrow was supported.

Short General Description: A small bird (sparrow).

Reproduction Comments: Clutch size 3-5 (usually 4). Incubation 11-14 days. There may be 2 broods per year. Both parents tend altricial young, which leave nest in 9-12 days.

Non-Migrant: Y

Locally Migrant: Y
Long Distance Migrant: Y
Mobility and Migration Comments: Breeding populations in Canada and northern U.S. are long-distance migrants, winter south to southern Mexico; migrates to northern part of nesting range in April-May (Terres 1980). Central American breeders are sedentary.

Terrestrial Habitat(s): Cropland/hedgerow, Grassland/herbaceous, Savanna, Suburban/orchard, Woodland - Conifer, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: Open woodlands, woodland edges, edges of lakes and streams, grassy fields, parks, farm yards, and orchards.
BREEDING: Usually nests in trees and shrubs, usually within 1-6 m of ground but may be higher.

Adult Food Habits: Granivore, Invertivore

Immature Food Habits: Granivore, Invertivore

Food Comments: Feeds on seeds (e.g., grasses, clover, ragweed, knotweed) spiders, and insects (e.g., weevils, beetles, caterpillars, grasshoppers). Mainly forages on the ground, but also in foliage.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 14 centimeters

Global Status: G5
Global Status Last Reviewed: 04Dec1996
Global Status Last Changed: 04Dec1996
Rounded Global Status: G5 - Secure

National Status: N5B, N5N
State Status: Delaware (S3N,S5B)

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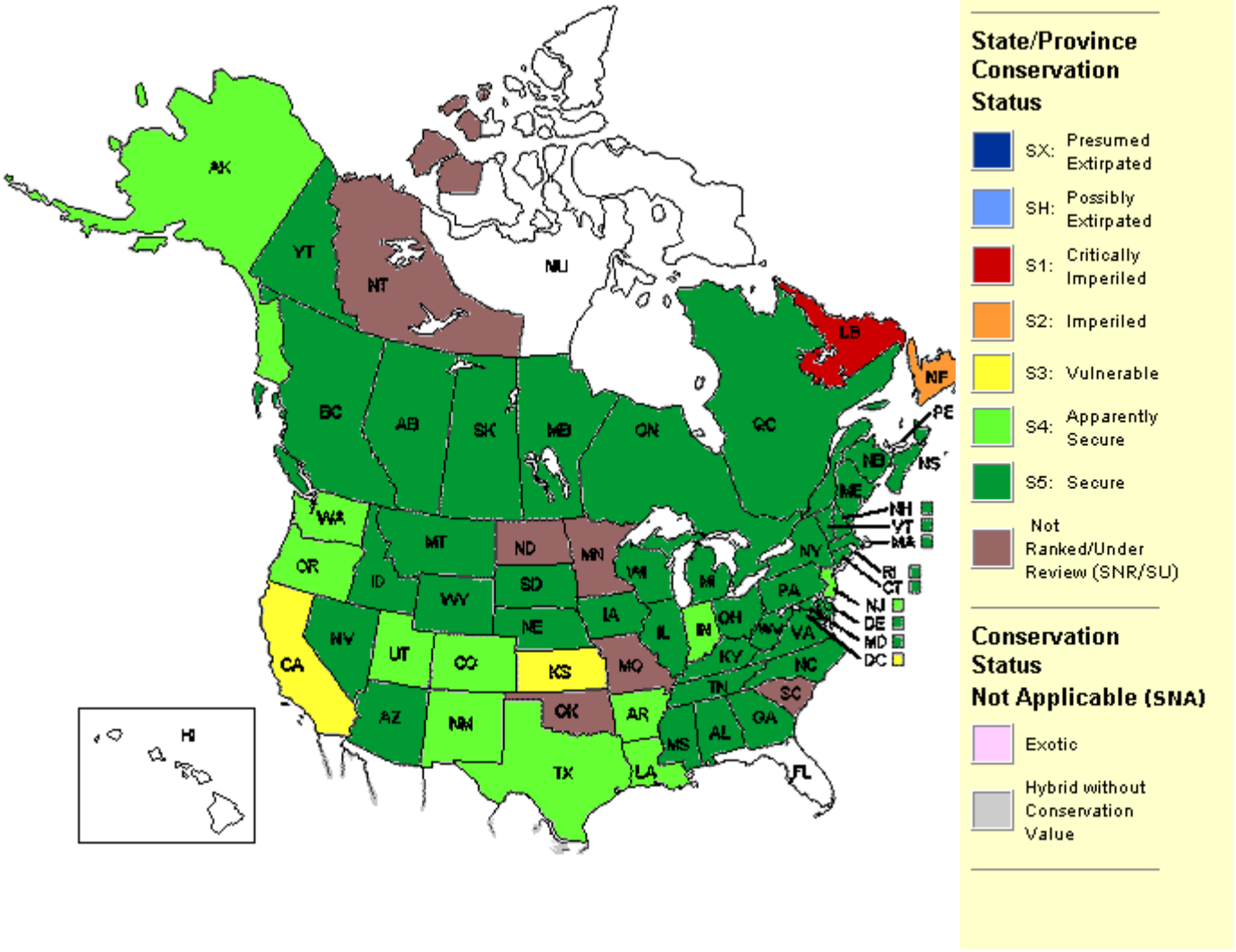
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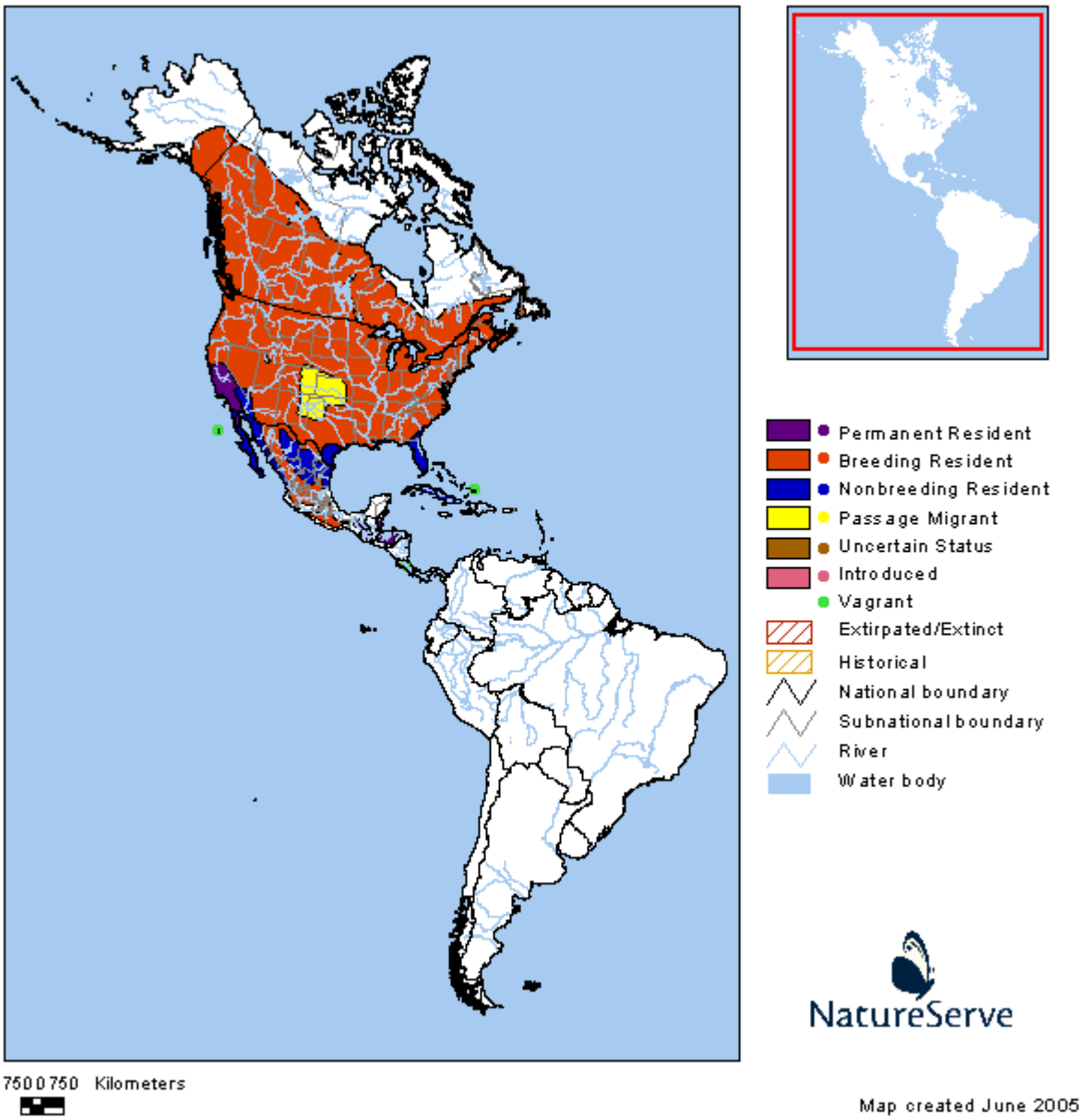
State/Province Conservation Status
SX: Presumed Extirpated
SH: Possibly Extirpated
S1: Critically Imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently Secure
S5: Secure
Not Ranked/Under Review (SNR/SU)
Conservation Status
Not Applicable (SNA)
Exotic
Hybrid without Conservation Value


Permanent Resident
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Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Seiurus aurocapilla - (Linnaeus, 1766)
Ovenbird

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Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Parulidae	Seiurus

Genus Size: B - Very small genus (2-5 species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Seiurus aurocapillus
Taxonomic Comments: Formerly known as Seiurus aurocapillus, but changed for grammatical reasons (AOU 2003).

Short General Description: A small bird (wood warbler).

General Description: A plump-looking, 15-cm-long bird with a thin pointed bill, pinkish legs, russet crowned bordered by darks stripes, bold white eye ring, olive dorsum, and white venter with bold dark streaks of spots (NGS 1983).

Reproduction Comments: PHENOLOGY: Nests from May-July (Terres 1991). First breeds in the spring after hatching (Van Horn and Donovan 1994).

OVIPOSITION/INCUBATION: Typically produces one clutch per year, although sometimes two or three (Hahn, 1937, Zach and Falls 1975). Average clutch size for 27 nests in Michigan was 4.7 eggs (range = 3-6). First clutches typically had five eggs, subsequent clutches 3-5 (Hahn 1937; statistically significant difference between first and later clutches; Zach and Falls 1975). Mean clutch size of 78 clutches was 4.4 eggs (Van Horn and Donovan 1994). A female that nested three times in one season in Michigan laid a total of 10 eggs (Hahn 1937), another in Ontario laid 13 eggs (Zach and Falls 1975). Eggs are laid every other day and incubation begins after the penultimate egg is laid (Hahn 1937). Females alone incubate the eggs and brood the young. Incubation period ranges from 11.5-14 days (mean = 12.25).

FLEDGING: Young leave the nest when 6.5-8.5 days old (mean = 8), and are capable of flight at 11 days old (Hahn 1937). Both parents feed the young. The brood is typically divided between the parents after the young leave the nest.

NEST SUCCESS: In Michigan, 63.4% of eggs hatched and 43.5% of young fledged (Hahn 1937); in Minnesota, nest success (fledged at least one young) ranged from 75-100% (Hanski, et al. 1996) and in Arkansas, it was 71.4% (Martin 1993).

Ecology Comments:
TERRITORY SIZE/DENSITY: Territory size and male density varies with prey abundance and size of inhabited forest. Territory size of 13 males studied in Ontario ranged from 0.6-1.6 hectares (mean = 0.8) and inversely correlated with the biomass of invertebrate prey, with territory size decreasing as prey biomass increased (Stenger 1958). A negative correlation between territory size and prey abundance was also observed in Tennessee (Smith and Shugart 1987). In Ontario, territory size was significantly smaller during a spruce budworm (CHORISTONEURA FUMIFERANA) outbreak than during non-budworm years (Zach and Falls 1975). Also territorial on the wintering grounds (Rappole and Warner 1980).

In Ontario, densities of males ranged from 0.33-8.3/10 hectares, and increased significantly with increasing woodlot core area (core area is forest 3100 meters from the forest edge; Burke and Nol 1998). In central Missouri, male population density ranged from 0.66-1.73/10 hectares, and increased with increasing forest size (Wenny et al. 1993). Density of males was positively related to size of forest tract and core area in eastern Pennsylvania, ranging from 1.3-7.2 males/10 hectares (Porneluzi et al. 1993). In a managed-forest landscape in New Brunswick, density of males in forest fragments (1.1/10 ha) did not differ statistically from a large contiguous forested tract (1.9/10 ha; Sabine et al. 1996). In northern hardwood forest in New Hampshire, average population density was 13.5 birds/10 hectares (Sabo and Holmes 1983).

SITE FIDELITY: Exhibits breeding site fidelity. In Illinois, 3 of 8 (37.5%) of those banded one year were recaptured the subsequent year (Robinson 1992). Of 22 adults and 40 young banded one year in Michigan, 10 adults (45%) and one yearling (2.5%) returned to the study area the following year. The three returning males occupied their former territory, whereas females either returned to their former territory or occupied an adjacent territory. The following year, the three males again returned and occupied their former territories (Hahn (1937). In New Jersey, 36% of adults and 10% of young banded in one year returned the following year (Leck et al. 1988). In Missouri, an average of 41% of males banded one year returned the

next; 64% had second-year territories with >50% overlap with first-year territories, and 26% were adjacent to or overlapped <50% with the territory of the previous year (Porneluzi and Faaborg 1999). Also exhibits site fidelity to wintering grounds (Faaborg and Arendt 1984, Kricher and Davis 1986, Martin and Carr 1986).

POPULATION PARAMETERS: Annual survivorship of birds in Pennsylvania and Michigan was estimated to be 54% (Hahn 1937, Savidge and Davis 1974 cited in Van Horn and Donovan 1994). Overwinter survival rates did not differ between mature and early-successional forests in Belize (Conway et al. 1995). Oldest known individual was 9 years old (Dowell and Robbins 1998).

PARASITES: Adults are host to six species of external parasites, including two lice (MENACANTHUS CHRYSOPHAEUM, MYRSIDEA INCERTA), three ticks (HAEMAPHYSALIS LEPORISPALUSTRIS, IXODES BRUNNEUS, IXODES DAMMINI), and one mite (LIPONYSSUS SYLVIARIUM; Peters 1936 cited in Van Horn and Donovan 1994). Mites have also been found on nestlings (Hahn 1937).

Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Principally follows the Atlantic and Mississippi flyways during migration, although some individuals use the Pacific flyway. Migration is apparently nocturnal (Van Horn and Donovan 1994). Spring migrants leave Costa Rica beginning in March and Puerto Rico in April (Raffaele 1989, Stiles and Skutch 1989), and arrive in Florida from late March through mid-May, with a peak in mid-April (Bent 1953, Taylor and Kershner 1986). In Kentucky, males typically return during the third week of April (Palmer-Ball 1996). Arrives in Michigan from late April through mid-May (Hahn 1937) and in Canada in late May and early June (Bent 1953). Based on kills at towers, fall migration peaks during the latter half of September in Ohio, Illinois, and Iowa, mid-September in New Jersey and late September through early October in Florida (Van Horn and Donovan 1994). Fall migrants arrive in the Neotropics from early September through late October (Raffaele 1989, Stiles and Skutch 1989). Sexes may migrate separately; males in Michigan arrive 9-14 days ahead of females (Hahn 1937).

Estuarine Habitat(s): Scrub-shrub wetland

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Shrubland/chaparral, Woodland - Hardwood, Woodland - Mixed

Habitat Comments:
BREEDING: Typically nests in mid-late successional, closed-canopied deciduous or deciduous-coniferous forests that have deep leaf litter and limited understory (Van Horn and Donovan 1994). Also nests in coniferous forest if deciduous forest is unavailable (Noon et al. 1980). Inhabited forest types include oak (QUERCUS)-hickory (CARYA), oak-pine (PINUS), maple (ACER)-basswood (TILIA), maple-birch (BETULA), maple-birch-beech (FAGUS GRANDIFOLIA), hemlock (TSUGA CANADENSIS)-oak, Trembling Aspen (POPULUS TREMULOIDES), and spruce (PICEA)-fir (ABIES) (Askins and Philbrick 1987, Freedman et al. 1981, Titterington et al. 1979, Van Horn and Donovan 1994, Westworth and Telfer 1993). Nests on the ground (Hahn 1937). In studies of regenerating forests

following clearcutting, found to be absent from, or in low densities in, young, shrubby, open-canopied stands; whereas they occurred in relative abundance in older, closed-canopied stands (Freedman et al. 1981, Thompson et al. 1992, Titterington et al 1979, Webb et al. 1977, Westworth and Telfer 1993).

NON-BREEDING: In the Caribbean region, utilizes a variety of habitats including coastal dry forest, elfin woodland, forest edge, pine forests, riparian forests, wet forests, wetlands, and urban areas (Arendt 1992). In Costa Rica, inhabits primary and secondary forest (Blake and Loiselle 1992); prefers shady understory of forest with well-developed shrub layer (Stiles and Skutch 1989). In Puerto Rico and surrounding islands, occurs in interior forests as well as mangroves and dry thickets (Raffaele 1989). Considered a forest generalist on the Yucatan Peninsula (Lynch 1989), and captured with equal frequency in primary and secondary forest in Veracruz (Rappole et al. 1992). In the Virgin Islands, inhabits both moist and dry evergreen forest, as well as transition zones between these forest types (Askins et al. 1992). Low numbers inhabit coffee, citrus, cacao, and pine plantations in Puerto Rico, Jamaica, Belize and Costa Rica (Robbins et al. 1992). Captured most frequently in pine savanna in Belize (Petit et al. 1992).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: BREEDING: Forages for invertebrate prey, principally that inhabiting the leaf litter, while walking or hopping along the ground. Prey is picked from leaf litter, off low vegetation, and the sides of logs (Stenger 1958). Foraging is concentrated in areas of greatest food abundance (Zach and Falls 1979). May forage in trees during outbreaks of larval insects such as the spruce budworm (CHORISTONEURA FUMIFERANA) and striped maple worm (Stenger 1958, Zach and Falls 1975). In New Hampshire, >50% of foraging attacks were directed towards prey in or on the leaf litter (Holmes and Robinson 1988). The stomach contents of 30 adults, obtained using an emetic, was dominated by Coleopterans, Dipterans, Hymenopterans, and Lepidopteran larvae (Holmes and Robinson 1988). In Ontario, the stomach contents of 98 dissected adults contained mostly leaf-litter-inhabiting insects, principally Coleopterans, Hymenopterans, Lepidopteran larvae, and unidentified insect larvae. Invertebrate prey are generally consumed in proportion to their availability (Stenger 1958).

NON-BREEDING: The winter diet includes plant as well as animal material. In Florida, Ovenbirds have been observed feeding on red mulberries (MORUS RUBRA). In Puerto Rico, the stomachs of 13 dissected individuals contained 62.5% animal and 37.5% plant material (Bent 1953).

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 15 centimeters
Weight: 19 grams

Global Status: G5
Global Status Last Reviewed: 20Dec2002
Global Status Last Changed: 03Dec1996
Rounded Global Status: G5 - Secure

Reasons: Large range; still common in many areas, though significant declines have occurred in some regions.

National Status: N5B
State Status: Delaware (S5B)

Stewardship Overview: On the breeding grounds, forest fragmentation has resulted in increased Brown-headed Cowbird (MOLOTHRUS ATER) nest parasitism, increased nest predation by a variety of predators, and reduced pairing and reproductive success. Habitat is also lost or degraded, in the short-term, by clearcutting or other forms of timber harvest that open the canopy. Deforestation is the primary threat to wintering birds. Large forested tracts are required to maintain viable (self-sustaining) breeding populations. Minimum forest fragment size necessary to maintain a viable breeding population varies with geography and surrounding land use. Due to the prevalence of Brown-headed Cowbirds, forest fragments in the western portion of the Ovenbird's range need to be larger than those in the eastern portion. Forest fragments in an agricultural landscape need to be larger than those in a managed-forest landscape. In addition, forest fragments isolated from other forested tracts are less suitable than fragments close to other forests. Mature, closed-canopied forests are preferred for breeding. Where management objectives include timber harvest, single-tree selection is the most appropriate means of extracting the timber resource while simultaneously maintaining habitat.

Restoration Potential: Does not appear to need urgent recovery/restoration efforts. As second-growth forests mature, breeding habitat should become more suitable. However, these second-growth forests are also becoming more suitable for harvest. If logging is not conducted sustainably, large areas of habitat will be lost (P. Porneluzi, pers. comm.). The trend towards protecting larger tracts of land and restoring pre-Columbian plant communities, such as deciduous forest, should result in additional suitable breeding habitat. Recolonization of reforested areas following timber harvest indicates adaptability to changes in habitat availability/suitability. For example, a Connecticut population that declined following cutting of a nearby forest rebounded with reforestation (Askins and Philbrick 1987).

Preserve Selection & Design Considerations: Although classified as a forest-interior, area sensitive species (Freemark and Collins 1992), will nest in woodlots as small as 4 hectares in size (Forman et al. 1976, Galli et al. 1976). Minimum area requirements vary across the range. The minimum forested area required to maintain a viable breeding population in Maryland was estimated to be 100 hectares, though maximum densities occur in forested tracts >2650 hectares (Robbins 1979 cited in Bushman and Therres 1988). In Missouri, did not occur in tracts <341 hectares in extent (Hayden et al. 1985). Burke and Nol (1998) suggest that the minimum forest fragment size necessary for successful reproduction in Ontario is 380 hectares, with a 20 hectare core area (amount of habitat at least 100 meters from edge). Due to edge effects, Van Horn et al. (1995) recommended that calculations of the minimum-area requirement focus on core areas (which they defined as habitat 300 meters from the forest edge) rather than the area of the entire forest. Fragmentation effects are influenced not only by fragment size, but by the habitat surrounding the fragment. A forest fragment embedded within an agricultural landscape and isolated from other forest fragments is less suitable than a fragment embedded within a managed-forest landscape or close to other forest fragments. In South Carolina, for example, Ovenbirds inhabited hardwood stands surrounded by pine plantations, but were absent from hardwood stands of similar size surrounded by agricultural habitat (Kilgo et al. 1997). In Minnesota, edge effects (reduced nesting success due to nest predation/parasitism) were not detected in a managed forest landscape (Hanski et al. 1996). In Maryland,

numbers were positively correlated with forest patch size, but negatively correlated with distance to forest tract 350 hectares in size (Lynch and Whigham 1984). As a result of reduced pairing/reproductive success, small, isolated forest fragments can act as reproductive sinks (Porneluzi et al. 1993, Porneluzi and Faaborg 1999). Forest fragmentation effects can be produced by forest-dividing corridors. For example, abundance was reduced significantly by forest-dividing powerline corridors averaging 22.5 meters wide (Rich et al. 1994). Observed only in riparian corridors 3175 meters wide in a study of bird use of riparian corridors traversing agricultural land in Iowa (Stauffer and Best 1980).

Management Requirements: Large, contiguous forested tracts are needed for successful breeding in order to maintain long-term population viability (Burke and Nol 1998, Porneluzi and Faaborg 1999). Larger tracts are required in the Midwest, smaller in the north and east where densities are higher (P. Porneluzi, pers. comm.). If setting aside large tracts is not possible, land managers should strive to minimize edge-to-interior ratios on small tracts, and prioritize for protection those small tracts in close proximity to forests that meet or exceed the minimum area requirement (Van Horn et al. 1995). In managed-forest landscapes, edge effects can be minimized by making clearcuts as circular as possible and creating fewer, but larger clearcuts because this results in less edge than many small clearcuts of the same area. In addition, the gradual transition from clearcut to shelterwood cut to forest interior may reduce predation rates (King et al. 1996). Uneven-age forest management may be the most compatible form of timber harvest. Single-tree selection and thinning of understory trees can maintain and create favorable habitat conditions (Crawford et al. 1981). However, caution should be exercised because populations can be reduced by selective logging that opens the canopy (Chadwick et al. 1986, Freedman et al. 1981, Robinson and Robinson 1999, and Yahner 1993).

Monitoring Requirements: The density of males, as determined by point counts or spot mapping techniques, is often used to determine the minimum forest area used for reproduction. However, the use of male density to access the use of forest fragments can be misleading. For example, unpaired males sing more frequently than paired males which can lead to the erroneous conclusion that habitats less suitable for reproduction are preferred (Gibbs and Wenny 1993). Furthermore, though male density can be high in small tracts, pairing/reproductive success is typically low (Hagan et al. 1996, Porneluzi et al. 1993, Van Horn et al. 1995). Pairing/reproductive success is a more sensitive measure of the value of a tract of forest than male density (Porneluzi et al. 1993).

Management Programs: No known land management programs aimed specifically at this species.
Monitoring Programs: Species is monitored on numerous North American Breeding Bird Survey (BBS) routes and during a limited number of Christmas Bird Counts (CBC). However, because BBS surveys are conducted along roads, they may not be the best means of monitoring forest-interior breeding birds (P. Porneluzi, pers. comm.). Long-term migrant bird counts, such as at Long Point, Ontario, also provide useful data with which to monitor population trends (Hussell, et al. 1992).
Management Research Programs: A focal species of the Missouri Ozark Forest Ecosystem Project (MOFEP), a long-term study initiated in 1991 to study the effects of forestry practices on the forest ecosystem. Data being collected on territory placement, density and nest success. For information on the MOFEP go to: http://www.snr.missouri.edu/mofep/overview/overview.html. Several researchers are collecting point count data in Ovenbird habitat. Information can be obtained at the following website: http://pica.wru.umt.edu/BBIRD/info.htm.

Management Research Needs: Little known regarding stopover ecology and other migration requirements,

or the ecology on the wintering grounds. Need more information on reproductive success in various habitats and landscapes (P. Porneluzi, pers. comm.). Also need data on densities in various habitats, and of use of small fragments, second-growth forests, and shrubby habitats bordering agricultural lands (Van Horn and Donovan 1994).

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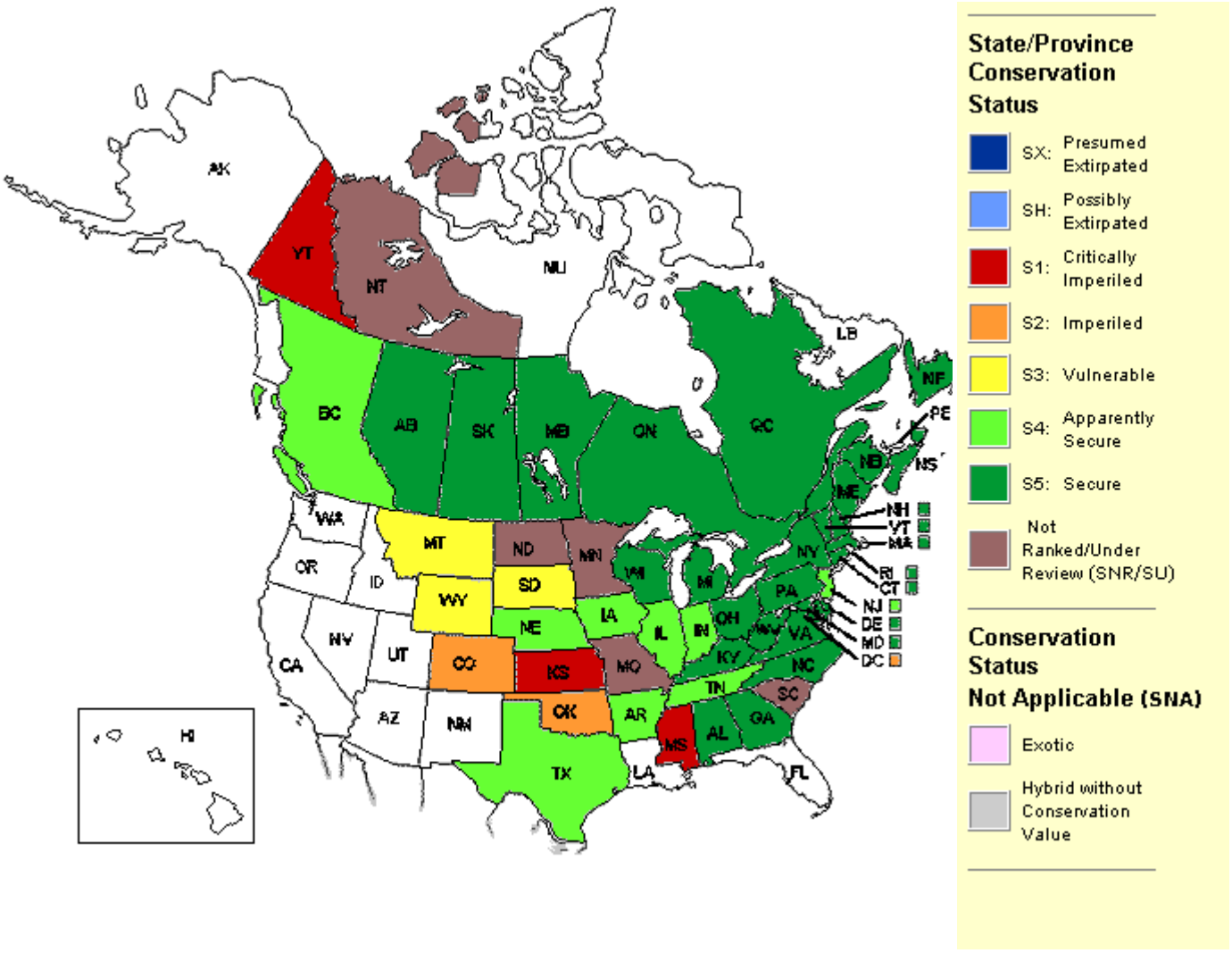

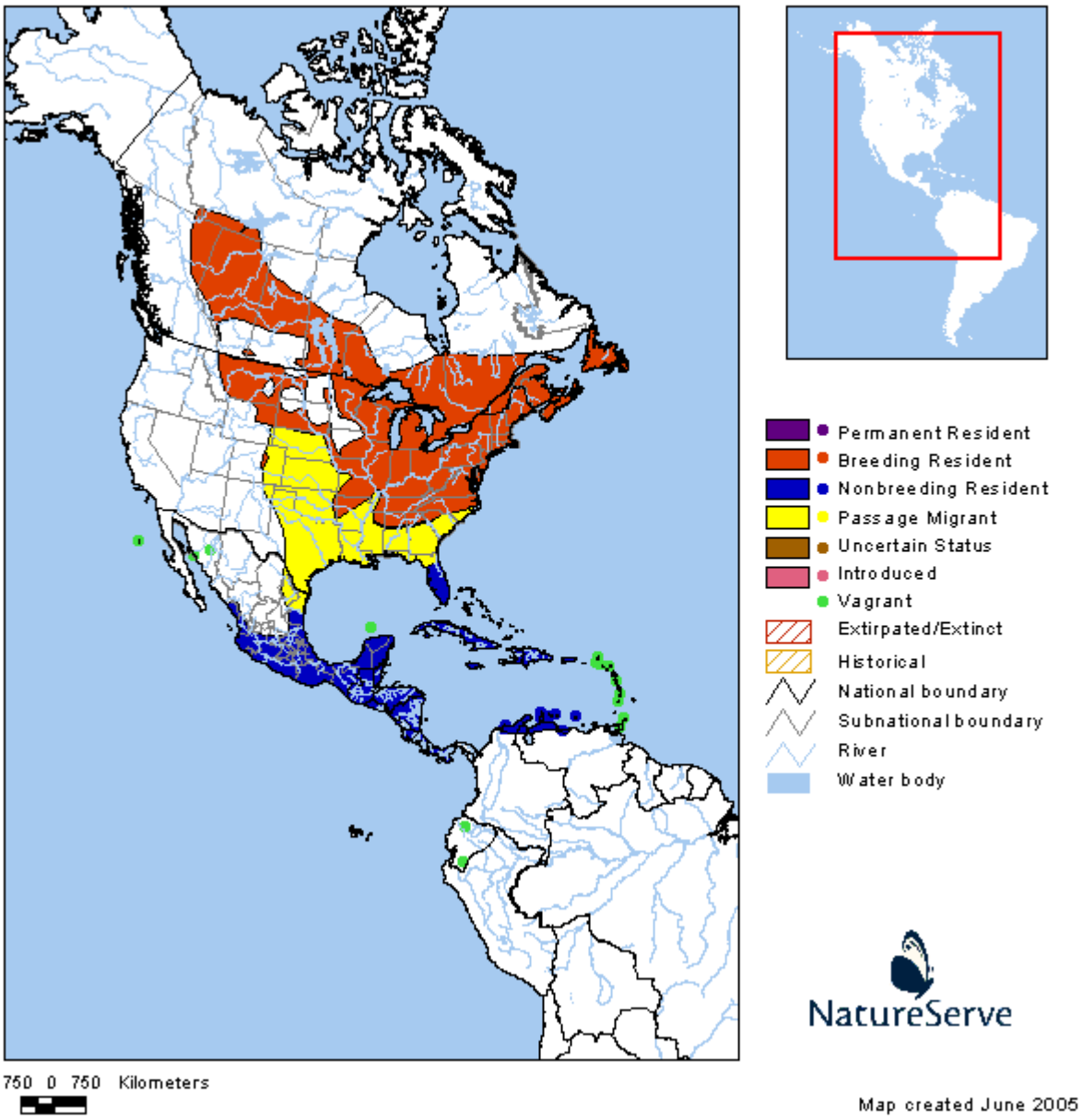
Permanent Resident
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National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

Vireo gilvus - (Vieillot, 1808)
Warbling Vireo

© Herbert Clarke

Kingdom	Phylum	Class	Order	Family	Genus
Animalia	Craniata	Aves	Passeriformes	Vireonidae	Vireo

Genus Size: D - Medium to large genus (21+ species)
Concept Reference: American Ornithologists' Union (AOU). 1998. Check-list of North American birds. Seventh edition. American Ornithologists' Union, Washington, DC. 829 pp.
Concept Reference Code: B98AOU01NAUS
Name Used in Concept Reference: Vireo gilvus
Taxonomic Comments: Recent studies indicate that western North America populations may be specifically distinct from those in eastern and central North America (AOU 1998); they differ morphologically, vocally, and genetically, with close approach and probable parapatry or sympatry in north-central Alberta; Sibley and Monroe (1990) treated these as separate species, V. GILVUS (eastern warbling vireo) and V. SWAINSONII (western warbling vireo). Relationships between V. GILVUS and V. LEUCOPHRYS remain uncertain; considered conspecific by some authors, they constitute a superspecies (AOU 1998). See Johnson et al. (1988) for evidence that LEUCOPHRYS is specifically

distinct from GILVUS. See Johnson et al. (1988) and Murray et al. (1994) for analyses of the phylogenetic relationships among vireos.

Reproduction Comments: Male and female, in turn, incubate 4, sometimes 3-5, eggs for about 12 days. Altricial young are tended by both parents, leave the nest in about 12-14 days.

Ecology Comments:
Density figures of 13.4 birds/40 ha have been recorded in flatland aspen; 60.0/40 ha in scrub-meadow; 5 pairs/40 ha in Douglas fir forest (Bureau of Land Management, no date). Nests often parasitized by Brown-headed Cowbirds, suffering up to 80% parasitism in some areas; this high rate, combined with the fact that parasitized nests typically produce no vireo young, can create sink populations, even in areas where vireos are common (Ward and Smith 2000).

Non-Migrant: N
Locally Migrant: N
Long Distance Migrant: Y
Mobility and Migration Comments: Migrates to U.S. nesting range April-May (Terres 1980).

Palustrine Habitat(s): Riparian

Terrestrial Habitat(s): Forest - Hardwood, Forest - Mixed, Savanna, Suburban/orchard, Woodland - Hardwood, Woodland - Mixed

Habitat Comments: Open deciduous and mixed deciduous-coniferous woodland, riparian forest and thickets, pine-oak association, orchards, and parks; in migration and winter in a wide variety of forest, woodland and scrub habitats (AOU 1983). In winter seems to prefer light woodland and savanna groves (Stiles and Skutch 1989). Usually nests at end of branch in a deciduous tree, 9-18 m above ground, or 1-3.5 m above ground, in shrub or orchard tree (Terres 1980).

Adult Food Habits: Invertivore

Immature Food Habits: Invertivore

Food Comments: Insectivorous. Feeds on caterpillars, beetles, grasshoppers, ants, etc. Also eats spiders and some berries. Forages in trees.

Adult Phenology: Diurnal

Immature Phenology: Diurnal

Length: 14 centimeters
Weight: 12 grams

Global Status: G5
Global Status Last Reviewed: 03Dec1996
Global Status Last Changed: 03Dec1996

Rounded Global Status: G5 - Secure

National Status: N5B
State Status: Delaware (S2B)

Global Short Term Trend Comments: Breeding Bird Survey data indicate significant population increases throughout North America, 1966-1989, and in western North America, 1978-1988 (Droege and Sauer 1990, Sauer and Droege 1992).

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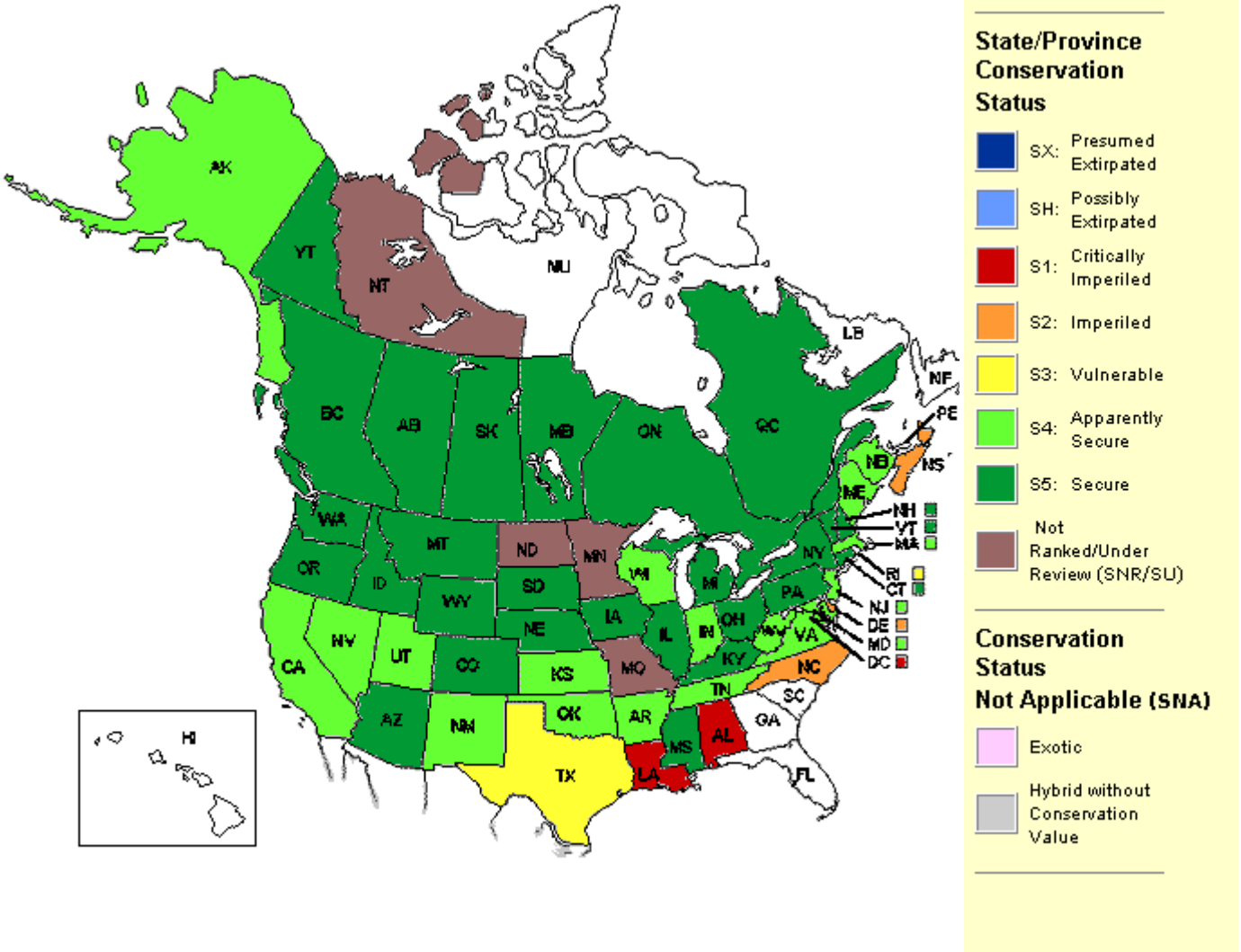
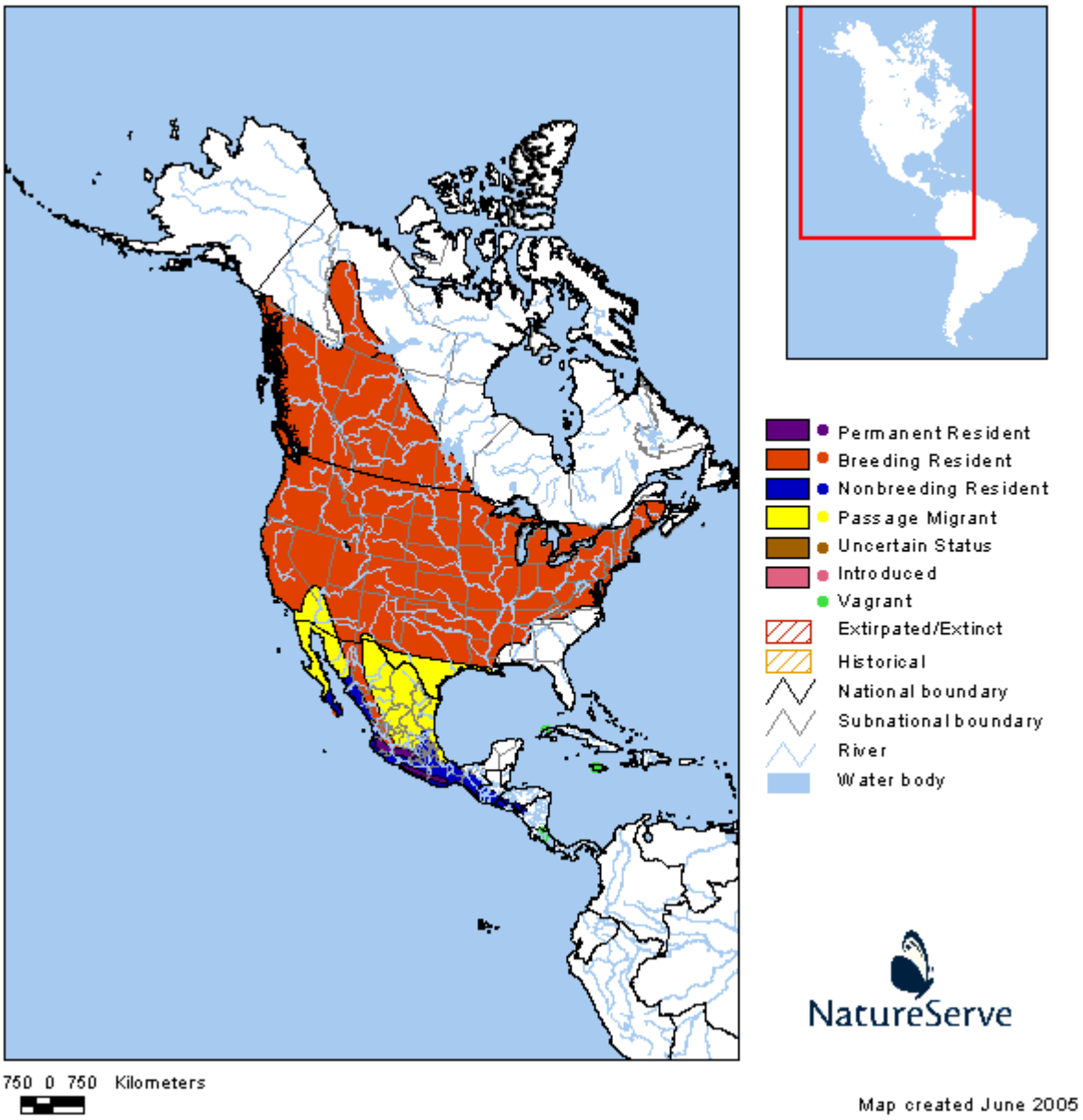
http://www.natureserve.org/explorer/servlet/NatureServe?menuselect=none&sourceTemplate=tabular_report.wmt&loadTemplate=species_RptComprehensive.wmt&selectedReport=RptComprehensive.wmt&summaryView=tabular_report.wmt&elKey=102429&paging=home&save=true&startIndex=1&nextStartIndex=1&reset=false&offPageSelectedElKey=102429&offPageSelectedElType=species&offPageYesNo=true&post_processes=&radiobutton=radiobutton&selectedIndexes=102429&menuselectfooter=none




Permanent Resident
Breeding Resident
Nonbreeding Resident
Passage Migrant
Uncertain Status
Introduced
Vagrant
Extirpated/Extinct
Historical
National boundary
Subnational boundary
River
Water body
NatureServe
750 0 750 Kilometers
Map created June 2005

VEGETATION COMMUNITIES PLS

Historical Context of Vegetation at the RRTS

Prior to human disturbance, the wetland areas of the NCRR would have supported a diverse plant community typical of brackish tidal marshes of the Mid-Atlantic Coastal Plain. The dominant plants in undisturbed communities of this type are narrow-leaved cattail (*Typha angustifolia*), big cordgrass (*Spartina cynosuroides*) and Olney three-square (*Scirpus americanus*). Associated species vary with the soil type and salinity of the tidal marsh (Sneddon et al., 1995).

Transition areas between tidal wetlands and uplands would have consisted of non-tidal, forested wetlands, which would have been dominated by red maple (*Acer rubrum*) and blackgum (*Nyssa sylvatica*). Non-wetland areas at the NCRR are likely to have supported upland deciduous forests prior to clearing for agriculture. The NCRR is located in the transitional area between the eastern deciduous forest and southeastern mixed forest provinces (DEARNG, 1995). Potential natural vegetation, classified by Kuchler, is oak-hickory-pine forest and southern floodplain forest. The predominant vegetation form is needle-leaved evergreen forest and smaller areas of deciduous broad-leaved forests. The main forest cover type is loblolly pine-hardwood, where hardwood species consist of sweetgum, water oak, white ash, yellow-poplar, red maple, and swamp hickory. On bottomland areas along major rivers, species include green ash, sugarberry, water oak, American sycamore, sweetgum, and American elm.

Human disturbances have altered the vegetative communities for over a century. Prior to occupation by DEARNG in 1908, the NCRR was a cultivated agricultural site. By the early 1800s, most brackish tidal marshes along the Delaware River had been diked and converted to agricultural land for crops or grazing. Natural vegetation has been cleared for agriculture on about 65 percent of the Middle Atlantic Coastal Plain. Land cleared for agriculture typical is one of the first areas considered for future development. Development pressures have accounted for an additional percentage decline and species change from natural vegetation conditions. Land cover type mapping across the mid-Atlantic region indicates a similar pattern. However, land cover types at the NCRR do not follow this pattern.

Vegetation Community Mapping Process

The previous INRMP (2001) included a field survey and mapping of vegetation communities at the RRTS. The vegetation communities were separated into three cover classes: 1) Terrestrial (upland), 2) Palustrine and 3) Estuarine, based on the Cowardin (Cowardin, et al., 1979) wetland classification system, which had been developed for the National Wetland Inventory. The study team at that time determined that the Cowardin system had applicability at the RRTS due to the abundance of wetlands there. Vegetation communities were delineated in the field and mapped based largely on cover type. Vegetation sampling was conducted across multiple cover types. While certain cover types were unique (i.e. mowed grass/landscape & mowed grass/shrubland) they were grouped together based on the extent of mowing. Other cover types such as impervious surface (road), intertidal unconsolidated shore, or tidal creek (deep water) were not sampled because they contained no vegetation.

In 2005, the vegetation communities at the RRTS were re-assessed. The Corps study team delineated and mapped these areas in the same fashion as the original mapping. Additionally, the mapped vegetation communities were compared to the Delaware Gap Analysis Project land cover data set, updated in March 2002, for consistency. Nominally, the minimum mapping unit (MMU) is 2 hectares and the scale is 1:100,000 for the land cover map. However, the data was further modified to a MMU of 30 meter pixel and a scale of 1:24,000. This data set used the National Vegetation Classification System (NVCS) as the basis for the classification. The basic unit is the Map Class, and for vegetated classes is delineated to dominant canopy species, most of the classes ended as aggregates of alliances based on ecological similarities. This data set also provides information on the relationship of each Map Class to the Anderson et al. (1976, USGS) Level I or LL code, the National Land Cover Data (MRLC 1999) code and the Delaware Gap wildlife habitat codes.

Vegetation Change Summary

The 2001 analysis yielded 14 cover types at the RRTS: the Terrestrial cover class consisted of seven cover types; the Palustrine cover class consisted of two cover types and the Estuarine cover class consisted of five cover types. The Terrestrial cover class accounted for approximately 56 percent (105 acres) of the total training site (approximately 190 acres). The Palustrine cover class was found on approximately 7 percent (13 acres) of the total training site. The Estuarine cover class covered approximately 38 percent (74 acres) of the total training site.

The 2005 analysis identified 15 cover types for the RRTS: the Terrestrial cover class consisted of eight cover types; the Palustrine cover class consisted of three cover types and the Estuarine cover class consisted of four cover types. The Terrestrial cover class covered approximately 104 acres (55 percent) of the RRTS (approximately 190 acres). The Palustrine cover class accounted for approximately 17 acres (10 percent), and the Estuarine cover class covered approximately 69 acres (36 percent).

From the 1990's until 2005 the RRTS has experienced modest vegetation community changes. The RRTS vegetative cover consists of approximately 30 percent forest or grassland, 24 percent mowed lawn or impervious surface (pavement or buildings), and approximately 46 percent wetlands. For the 2005 analysis, portions of the Terrestrial mowed lawn cover type were reclassified as Palustrine Emergent wetland, because those polygons met the jurisdictional wetland criteria. The most significant portion of this reclassification occurred in the designated "reforestation area" adjacent to the rifle range. Other portions of the mowed lawn cover type have grown into to mowed Grass/Shrubland habitat and Shrubland habitat, while portions of the former Shrubland habitat cover type have grown into to Mixed Successional Forest, especially within the "down range road loop."

Another significant reclassification for 2005 is the almost entire change (over 95 percent) from a *Phragmites* Brackish Tidal Marsh to native species-dominated Brackish Tidal Marsh. This change is presumed to be a result of DEARNG's active participation in the DNREC *Phragmites* control initiative. There were no other significant changes to the ecological communities at the RRTS.

Terrestrial Vegetation

The terrestrial system consists of uplands habitats that have well-drained, dry to mesic (never hydric) soils. Vegetative cover in this system is never predominantly hydrophytic, even if the soil surface is occasionally or seasonally flooded or saturated (Reschke, 1990). Ecological communities in the terrestrial system occupy approximately 104 acres of the installation. These communities include disturbed forest/edge, mixed hardwood-oak forest, mowed grass/landscaping, shrubland, successional grassland, successional hardwood forest, and roads and buildings.

Disturbed Forest/Edge: This community occupies about 5 acres and consists of species such as red maple (*Acer rubrum*), oriental bittersweet (*Celastrus orbiculatus*), Japanese honeysuckle (*Lonicera japonica*), winged sumac (*Rhus copallina*), and multifloran rose (*Rosa multiflora*). Located primarily along the western boundary of the RRTS, these invasive species have become established as a result of disturbance.

Mixed Hardwood-Oak Forest: This forest community occupies approximately 32 acres in the northern part of the installation. The dominant species of this community are white oak (*Quercus alba*), southern red oak (*Quercus falcata*), willow oak (*Quercus phellos*), red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), and American holly (*Ilex opaca*).

Shrubland: A distinct community of shrubs is present in the southeast part of the installation. The numerous patches of shrubland collectively occupy 3 acres of land. These patches are generally surrounded by areas of mowed grass and are in various stages of succession. Shrubland species include blueberry (*Vaccinium* sp.), southern arrowwood (*Viburnum dentatum*), and sweetgum (*Liquidambar styraciflua*).

Successional Grassland: Successional grassland habitat covers approximately 2 acres, and occurs in two locations at the RRTS. The first is a remnant of past disturbance in the mixed hardwood-oak forest, and encompasses only about one percent of the installation. This successional grassland community is located in the central portions of the mixed hardwood-oak forest community, in the northern part of the RRTS. Many young trees and herbaceous species are found in this community, including black cherry (*Prunus serotina*), bayberry (*Myricaheterophylla*), sweetgum, hyssopleaf thoroughwort (*Eupatorium hyssopifolium*), flattop (*Euthamia graminifolia*), and broom-straw (*Andropogon* sp.).

VEGETATION COMMUNITY COVERAGE AT RRTS

Vegetation Community	Calculated Area[1]		Percent of Installation
	Acres	Hectares	
TERRESTRIAL			
Disturbed Forest/Edge	5	2	3
Mixed Hardwood-Oak Forest	32	13	17
Mixed Successional Forest	7	3	4
Mowed Lawn/landscaping	35	14	18
Roads and Buildings	12	5	6
Shrubland	3	1	2
Successional Grassland	2	1	1
Successional Hardwood Forest (RMSG)	8	3	4
	104	**42**	**55**
PALUSTRINE			
Emergent Wetland	5	2	3
Red Maple/Black Gum Swamp	<1	<1	<1
Scrub Shrub Wetland	12	5	6
	16	**8**	**9**
ESTUARINE			
Estuarine Emergent Brackish Marsh	62	25	33
Phragmites Brackish Tidal Marsh	1	1	<1
Intertidal Unconsolidated Shore	2	<1	<1
Tidal Creek	5	2	3
	70	**28**	**36**
TOTALS	**190**	**78**	**100**

[1] Area calculations are based on the land cover mapping found in this report. The percent area calculations are based on a total area for RRTS of approximately 189 acres.

Figure: Vegetation Communities at the RRTS

Photo: Mixed Hardwood Forest

Photo: Shrubland Habitat

Photo: Successional Grassland Community in the Central Portion of the RRTS

Photo: Successional Grassland Community in the Designated “Reforestation Area”

The second successional grassland habitat area is located to the south of the warehouse area, within the designated "reforestation area." This area was formerly mowed, but is being allowed to grow as part of the reforestation project. Water is abundant at this location, due most likely to runoff from the paved area surrounding the warehouse and shop buildings. Because of this, the plants in this area tend to be "wetter" species. Dominant species are mixed rushes and sedges, including soft rush (*Juncus effusus*), green bulrush (*Scirpus atrovirens*), yelowfruit sedge (*Carex annectens*), and broomsedge (*Carex scoparia*). Other plants of note include Maryland meadowbeauty (*Rhexia mariana)*, seedbox (*Ludwigia alternifolia*), and sandplain flax (*Linum intercursum*).

Successional Hardwood Forest: Approximately 8 acres of land in the central and southeastern portions of the RRTS are currently occupied by this community. Although younger than the mixed hardwood-oak forest, this community contains many of the same species. Red maple and sweetgum are abundant, and white oak, American holly, tulip poplar (*Liriodendron tulipifera*), and sassafras (*Sassafras albidum*) are present as well.

Palustrine Vegetation

Red Maple/Blackgum Swamp: This forested wetland community accounts for less than 1 acre of the land at the RRTS. It occurs at low elevations within the mixed hardwood-oak forest community, on the northern portion of the installation. The dominant species of the area are red maple and blackgum, but other species such as sweetgum, and black cherry are also present.

Photo: Successional Hardwood Forest, with Delaware River in Background

Photo: Red Maple / Blackgum Swamp

Scrub/Shrub Wetland: This community occupies 12 acres of land at the RRTS, and is generally found along the eastern edge of the mixed hardwood-oak and successional forest communities. These edges represent a transition between the upland and wetland systems and are predominantly vegetated by southern arrowwood (*Viburnum dentatum*).

Palustrine Emergent Wetland: This community is described above as the second Successional Grassland community.

Estuarine Vegetation

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are saline, but where salinity is less than 30 parts per thousand. These areas have access to ocean water, although access is typically restricted by surrounding land and salinity is somewhat diluted by freshwater from upland areas (Mitsch and Gosselink, 1993). At the RRTS, the communities of the estuarine system include the following: Estuarine Emergent Brackish Tidal Marsh, *Phragmites* Brackish Tidal Marsh, Intertidal Mudflat, Intertidal Unconsolidated Shore, and Tidal Creek.

Estuarine Emergent Brackish Tidal Marsh: Approximately 62 acres, or 33 percent of the land cover at RRTS is classified as Estuarine Emergent Brackish Tidal Marsh. This vegetation community is dominated by saltmarsh cord grass (*Spartina alterniflora*) and big cord grass (*S. cynosuroides*), and represents the largest vegetative community at the RRTS. This vegetation community includes species which grow along the shore of the Delaware River, and are partially submerged.

Phragmites Brackish Tidal Marsh: Less than 1 acre of the RRTS is classified as brackish tidal marsh that is dominated by *Phragmites.* Intensive efforts by the DEARNG over the last 5 years have seriously diminished the once dense stands of *Phragmites* that dominated the entire RRTS landscape along the Delaware River, allowing few other plants to coexist. Details of the *Phragmites* control program at the RRTS are presented in Appendix C.

Intertidal Unconsolidated Shore: A narrow shoreline is present along the eastern perimeter of the installation, between the Estuarine Emergent Brackish Marsh and the Delaware River. This relatively unvegetated community occupies approximately 2 acres of the RRTS.

Tidal Creek: Approximately 5 acres of the RRTS are occupied by the tidal creek community, which serves as the primary hydrologic link between inland marsh communities and the Delaware River. These narrow waterways are generally bordered on either side by Estuarine Emergent Brackish Tidal Marsh and unvegetated Intertidal Mudflats.

Turf and Landscaped Areas

Areas dominated by mowed grass comprise approximately 35 acres, primarily in the central and western portions of the property. Although a detailed survey of the vegetation in this community has not been conducted, the predominant species are likely to be fescues (*Festuca* spp.), and crabgrass (*Digitaria serotina*). Landscaping plants include mature trees such as oaks and maples, as well as a variety of horticultural plants that were not identified for the purposes of this report.

Photo: Estuarine Emergent Brackish Tidal Marsh, with Delaware River in Background

Photo: Intertidal Unconsolidated Shore on Delaware River

Photo: Mowed Grass with Mixed Hardwood Forest in the Background

WETLANDS PLS

Clean Water Act

Section 404 of the CWA also establishes a program to control the discharge of dredge or fill materials into waters of the United States (including wetlands). Other activities that have the potential to impact wetlands are also regulated under Section 404. The US Army Corps of Engineers (Corps) has jurisdiction over activities in waters and wetlands and administers the federal permit program. The Corps does not regulate adjacent buffer zones. Pre-approved general or nationwide permits may be available for specific minor activities in wetlands. State regulations related to wetlands are discussed below.

The Wetlands Act of Delaware

The Wetland Act of Delaware (7 Del. C. 1953, § 6601; 59 Del. Laws, c.213 § 1.) was established in 1973 to provide a legal basis for the preservation and protection of the state's coastal wetlands, as defined in § 6603. The Wetlands Act requires permits for activities such as dredging, filling, bulkheading, and construction of any kind in those wetlands, which are issued by the Department of Natural Resources and Environmental Control.

2005 Wetland Delineation at the RRTS

In conjunction with this INRMP, the Corps updated the wetland survey conducted by Wetlands Research Associates, Inc. (WRA) in 1992, and a Planning Level Wetlands Survey conducted by the U.S. Army Corps of Engineers, Waterways Experiment Station (WES) in 2000. Wetland investigations were conducted using pertinent published data and by performing wetland delineations on 17, 20, 22, 29 and 30 June 2005.

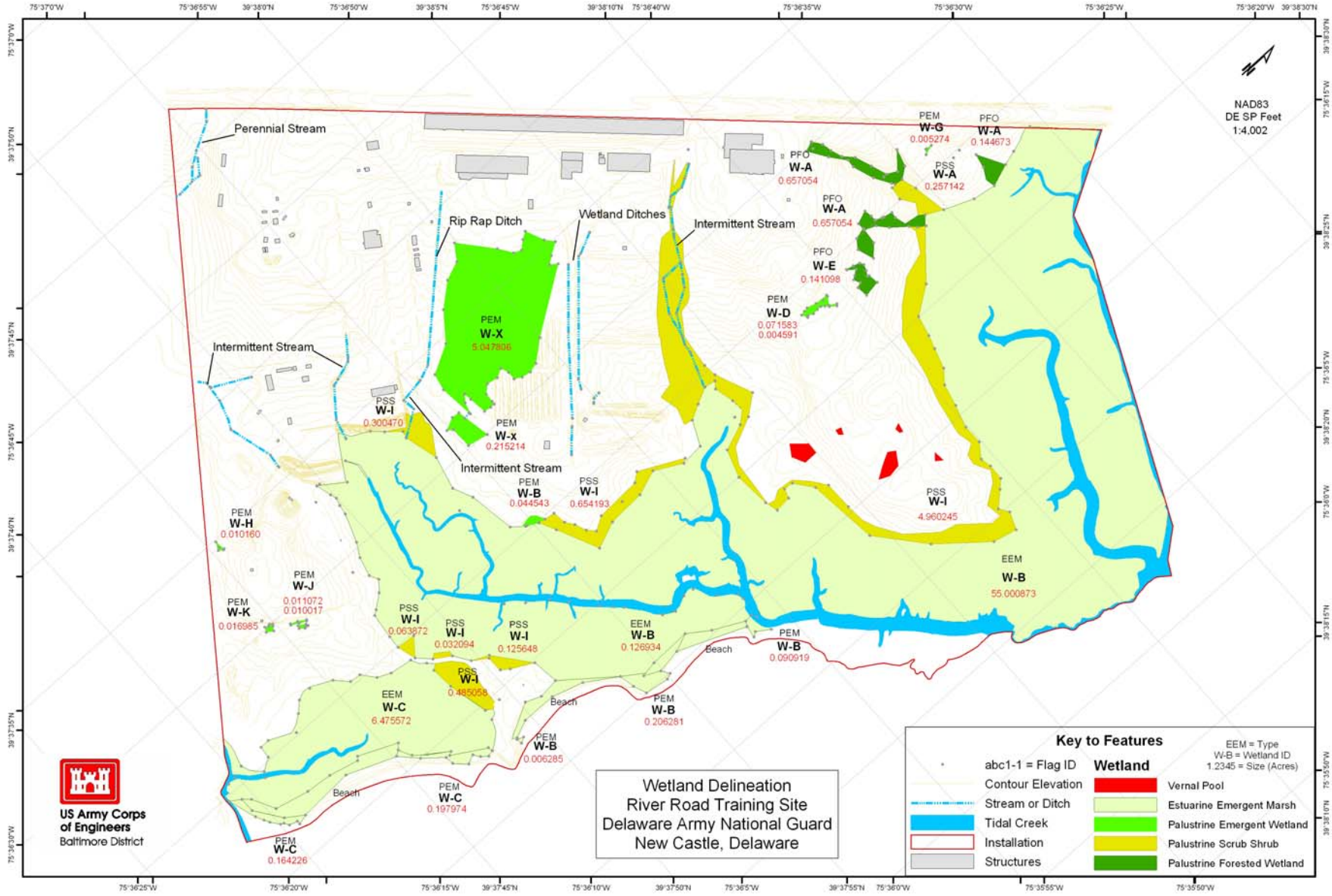
Wetland sites within the RRTS were delineated based on standard wetland delineation methodology. The wetland sites were differentiated and assigned "site letters" based on their cover class, dominant vegetative cover and landscape position. Wetland sites are lettered from A to K and an upland restoration area that turned into a wetland site is labeled as X. Within the Palustrine (P) cover class the wetland types ranged from emergent (EM) to scrub-shrub (SS) to forest (FO). In addition to the Palustrine Forest wetland type, a subcategory designated as vernal pool (VP) was delineated. Within the estuarine (E) cover class emergent (EM) was the only wetland type delineated. The table below shows the type and size of jurisdictional wetlands at NCRR. There are approximately 77 wetland acres, comprising both palustrine (14 acres) and estuarine (63 acres) wetland types.

WETLANDS AT THE RRTS

Wetland Identification	Wetland Type	Wetland Size (acres)
W-A	PFO	1.46
W-B	EEM	56.29
W-C	EEM	6.84
W-D	PEM	0.08
W-E	PFO	0.14
W-F	PFO-VP	0.28
W-G	PEM	0.01
W-H	PEM	0.01
W-I	PSS	6.62
W-J	PEM	0.02
W-K	PEM	0.02
W-X	PEM	5.26

The figure below shows these updated wetland boundaries at the installation. DEARNG activities are not presently conducted in these areas, nor do they plan to be in the future. The ecological communities associated with wetlands at the RRTS are discussed in the Vegetation PLS above.

Wetland data sheets are provided after the figure. These sheets were prepared as part of the delineation process to document dominant plants, non-dominant plants, hydrological conditions, and soils at each wetland location. These sheets are used as justification for the presence or absence of wetland criteria at these sites.



WETLANDS AT THE RIVER ROAD TRAINING SITE

Wetland Data Sheets

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range			Date 20 June 2005
Applicant / Owner United States Army – Delaware National Guard			County New Castle County
Investigator CENAB-PL-P (K. Luebke, C. Spaur)			State Delaware
Do Normal Circumstances exist on the site?	YES		Community ID Forested Wetland
Is the site significantly disturbed (Atypical Situation)?	NO		Transect ID Wetland Polygon A and E. Soil Profile flag RMSG2-S1
Is the area a potential Problem Area? (If needed, explain on reverse)	NO		Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 *Liquidambar styraciflua*	TREE	FAC	9		
2 *Acer rubrum*	TREE	FAC	10 *Osmunda cinnamomea*	HERB	FACW
3 *Eulalia vininium*	HERB	FAC	11 *Cornus amomum*	SHRUB	FACW
4 *Viburnum dentatum/recognitum*	SHRUB	FAC/FACW-	12 *Nyssa sylvatica*	TREE	FAC
5 *Vaccinium corymbosum*	SHRUB	FACW-	13 *Acer saccharinum*	TREE	FACW
6 *Impatiens capensis*	HERB	FACW	14 *Liriodendron tulipifera*	TREE	FACU
7 *Thelypteris noveboracensis*	HERB	FAC	15 *Quercus palustris*	TREE	FACW
8 *Osmunda regalis*	HERB	OBL	16 *Onoclea sensibilis*	HERB	FACW

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. The area was filled in at the top of the draw, near the parking lot.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	N/A	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☐ Sediment Deposits

☑ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☐ Oxidized Root Channels in Upper 12 Inches

☑ Water-Stained Leaves

☐ Local Soil Survey Data

☑ FAC-Neutral Test

☑ Other (Explain in Remarks)

SOILS

Wetland Polygon A and E

Map Unit Name (Series and Phase): Metapeake Silt Loam			Drainage Class: Well drained		
Taxonomy (Subgroup): Typic Hapludults			Field Observations Confirm Mapped Type? NO		
PROFILE DESCRIPTION (RMSG2 S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-5	A	10 YR 3/2	None	None	Silt Loam; subangular blocky, many roots
5-15+	B	2.5 Y 6/2	7.5 YR 5/6	Many, distinct	Sandy loam; subangular blocky; friable; Mn concretions

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☑ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:
There is low-chroma matrix color and bright redoximorphic feature color within 10 inches and below the A horizon. This location meets the basic rules for hydric soils.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met. While the soils are not listed as hydric, the wetland polygon(s) are small and are either in a draw or on the edge of the tidal marsh.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range	Date 20 June 2005
Applicant / Owner United States Army – Delaware National Guard	County New Castle County
Investigator CENAB-PL-P (K. Luebke, C. Spaur)	State Delaware
Do Normal Circumstances exist on the site? yes	Community ID Mixed Hardwood Oak Forest
Is the site significantly disturbed (Atypical Situation)? no	Transect ID Upland Soil Reference Wetland Polygons A, D, E, F, G
Is the area a potential Problem Area? (If needed, explain on reverse) no	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 *Liriodendron tulipifera*	TREE	FACU	9 *Ilex opaca*	TREE	FACU+
2 *Prunus serotina*	TREE	FACU	10 *Q. bicolor*	TREE	FACW+
3 *Nyssa sylvatica*	TREE	FAC	11 *Liquidambar styraciflua*	TREE	FAC
4 *Quercus marilandica*	TREE	NI	12 *Q. coccinea*	TREE	NI
5 *Q. falcate*	TREE	FACU-	13 *Q. phellos*	TREE	FAC+
6 Sassafras albidum	TREE	FACU-	14 *Thelypteris noveboracensis*	HERB	FAC
7 *Q. alba*	TREE	FACU-	15 *Osmunda cinnamomea*	HERB	FACW
8 *Acer rubrum*	TREE	FAC	16 *Viburnum dentatum*	SHRUB	FAC

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 25%

Remarks

This area does not meet the basic rule for hydrophytic vegetation. Other dominant vegetation: *Lycopodium obscurum* (FACU) and *Lycopodium digitatum* (NI).

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS		
Depth of Surface Water	N/A	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☐ Sediment Deposits

☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☐ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

UPLAND REFERENCE

Map Unit Name (Series and Phase): Metapeake Silt Loam				Drainage Class: Well Drained	
Taxonomy (Subgroup): Typic Hapludults			Field Observations Confirm Mapped Type? YES		
PROFILE DESCRIPTION (Flag RMSG U-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-3	A	10 YR 4/3	NONE	NONE	Silt Loam; subangular blocky; friable; numerous roots
3-10	E	10 YR 6/6	NONE	NONE	Silt loam; subangular blocky; friable; few & finer roots
10-16	B1	10 YR 6/8 or5/8	2.5 Y 7/2	Few; faint or indistinct soft masses (?)	Silt loam; subangular blocky; friable; clay films

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:
The permeability of this soil series is moderate to moderately slow with an apparent seasonal high water table around 48 inches in this low elevation. The B horizon, silt loam, sits atop the larger grain size (sands) of the C horizon. The slow permeability and larger pore space of the sandy C horizon may account for why mottles (soft masses and clay films) appear in the lower portion of the B horizon.

This location is not a hydric soil.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	NO	Is this Sampling Point Within a Wetland? NO
Wetland Hydrology Present?	NO	
Hydric Soils Present?	NO	

Remarks

The three wetland criteria are NOT met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site	New Castle Rifle Range		Date 20 June 2005
Applicant / Owner	United States Army – Delaware National Guard		County New Castle County
Investigator	CENAB-PL-P (K. Luebke, C. Spaur)		State Delaware
Do Normal Circumstances exist on the site?		YES	Community ID Tidal Marsh
Is the site significantly disturbed (Atypical Situation)?		NO	Transect ID Wetland Polygon B.
Is the area a potential Problem Area? (If needed, explain on reverse)		NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 *Peltandra virginica*	HERB	OBL	9 *Hibiscus muschutus*	HERB	OBL
2 *Pontederia cordata*	HERB	OBL	10 *Sparganium spp.*	HERB	OBL
3 *Acorus calamus*	HERB	OBL	11 *Schoenoplectus tabernaemontani*	HERB	OBL
4 *Iris pseudacorus*	HERB	OBL	12 *Rumex verticillatus*	HERB	OBL
5 *Leerisia orizoides*	HERB	OBL	13 *Sagitaria latifolia*	HERB	OBL
6 *Typha latifolia*	HERB	OBL	14 *Saururus cernuus* (invasive)	HERB	OBL
7 *Typha angustifolia*	HERB	OBL	15 *Scirpus fluviatalis*	HERB	OBL
8			16 *Carex lurida*	HERB	OBL

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. Other non-dominant vegetation includes: *Carex vulpinoidea* (OBL), *Carex crinita* (OBL), *Juncus effusus* (FACW+), *Juncus canadensis* (FACW+), *Eleocharis tenuis* (FACW+), *Iva Frutescens* (FACW+). Non-dominant invasive and/or exotic species include: *Apocynum cannabinum* (FAC), *Lythrum salicaria* (FACW+) and *Phragmites australis* (FACW) and dodder. Phragmites comprises less than 25% of the entire tidal marsh.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☑ Aerial Photographs

☑ Other (previous INRMP)

☐ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	0-12	(in)
Depth to Free Water in Pit	0-2	(in)
Depth to Saturated Soil	0	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☑ Inundated (onsite at high & low tide numerous days per quarter)

☑ Saturated in Upper 12 Inches

☑ Water Marks

☑ Drift Lines

☐ Sediment Deposits

☑ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☐ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☐ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon B

Map Unit Name (Series and Phase): Tidal Marsh, salty				Drainage Class: Very Poorly Drained	
Taxonomy (Subgroup):			Field Observations Confirm Mapped Type? Yes		
PROFILE DESCRIPTION (RMSG2 S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☑ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☑ Listed on Local Hydric Soils List
- ☑ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

Because of the aquic moisture regime and dominance by 100% Obligate plants, no soil profile was required. This location meets the basic rules for hydric soils.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met..

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site	New Castle Rifle Range		Date 17 June 2005
Applicant / Owner	United States Army – Delaware National Guard		County New Castle County
Investigator	CENAB-PL-P (K. Luebke, S. Pugh)		State Delaware
Do Normal Circumstances exist on the site?		YES	Community ID Tidal Marsh
Is the site significantly disturbed (Atypical Situation)?		NO	Transect ID Wetland Polygon C.
Is the area a potential Problem Area? (If needed, explain on reverse)		NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 *Sagitaria latifolia*	HERB	OBL	9 *Hibiscus muschutus*	HERB	OBL
2 *Acorus calamus*	HERB	OBL	10 *Sparganium spp.*	HERB	OBL
3 *Peltandra virginica*	HERB	OBL	11 *Schoenoplectus tabernaemontani*	HERB	OBL
4 *Iris pseudacorus*	HERB	OBL	12 *Rumex verticillatus*	HERB	OBL
5 *Typha latifolia*	HERB	OBL	13 *Pontederia cordata*	HERB	OBL
6 *Typha angustifolia*	HERB	OBL	14 *Saururus cernuus* (invasive)	HERB	OBL
7 *Leerisia orizoides*	HERB	OBL	15 *Scirpus fluviatalis*	HERB	OBL
8			16 *Iva Frutescens*	HERB	FACW+

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. Other non-dominant vegetation includes: *Carex vulpinoidea* (OBL), *Carex crinita* (OBL), *Juncus effusus* (FACW+), *Juncus canadensis* (FACW+), *Eleocharis tenuis* (FACW+), *Carex lurida* (OBL). Non-dominant invasive and/or exotic species include: *Apocynum cannabinum* (FAC), *Lythrum salicaria* (FACW+) and *Phragmites australis* (FACW). Phragmites comprises less than 15% of the entire tidal marsh.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☑ Aerial Photographs

☑ Other (previous INRMP)

☐ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	0-12	(in)
Depth to Free Water in Pit	0-2	(in)
Depth to Saturated Soil	0	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☑ Inundated (onsite at high & low tide numerous days per quarter)

☑ Saturated in Upper 12 Inches

☑ Water Marks

☑ Drift Lines

☐ Sediment Deposits

☑ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☐ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☐ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon C

Map Unit Name (Series and Phase): Tidal Marsh, salty	Drainage Class: Very Poorly Drained
Taxonomy (Subgroup):	Field Observations Confirm Mapped Type? Yes

PROFILE DESCRIPTION (RMSG2 S-1)

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☑ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☑ Listed on Local Hydric Soils List
- ☑ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

Because of the aquic moisture regime and dominance by 100% Obligate plants, no soil profile was required. This location meets the basic rules for hydric soils.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met. This tidal marsh (W-C) is separate from tidal marsh W-B because Sagitaria and Acorus increase in dominance compared to Peltandra/Pontadaria/Typha species. Additionally, there is half the amount of Phragrmities in this polygon.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range	Date 30 June 2005
Applicant / Owner United States Army – Delaware National Guard	County New Castle County
Investigator CENAB-PL-P (K. Luebke, C.Spaur)	State Delaware
Do Normal Circumstances exist on the site? YES	Community ID Emergent Wetland
Is the site significantly disturbed (Atypical Situation)? YES	Transect ID Wetland Polygon G.
Is the area a potential Problem Area? (If needed, explain on reverse) NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Scirpus atrovirens	HERB	OBL	*9 Juncus effusus*	HERB	FACW+
2 Onoclea sensibilis	HERB	FACW	*10 Typha latifolia*	HERB	OBL
3 Thelypteris palustris	HERB	FACW+	*11 Phragmites australis*	HERB	FACW
4 Microstegium vimineum	HERB	FAC	*12*		
5			*13*		
6			*14*		
7			*15*		
8			*16*		
Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100 %					

Remarks
This area meets the basic rule for hydrophytic vegetation. Complex of tire ruts and road drainage in a disturbed area.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge
☐ Aerial Photographs
☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	N/A (in)
Depth to Free Water in Pit	N/A (in)
Depth to Saturated Soil	0 (only the top 2 inches is saturated) (in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
- ☐ Inundated (onsite at high & low tide numerous days per quarter)
- ☐ Saturated in Upper 12 Inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
- ☑ Oxidized Root Channels in Upper 12 Inches
- ☐ Water-Stained Leaves
- ☐ Local Soil Survey Data
- ☑ FAC-Neutral Test
- ☐ Other (Explain in Remarks)

SOILS

Wetland Polygon G

Map Unit Name (Series and Phase): Metapeake Silt Loam				Drainage Class: Well Drained	
Taxonomy (Subgroup): Typic Hapludults			Field Observations Confirm Mapped Type? No		
PROFILE DESCRIPTION (Flag PEM10-2/S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-3	A	10 YR 6/1	10 YR 6/8	Few, distinct	Silt loam; subangular blocky; buried stump roots/materials
3-12	E or B	7.5 YR 5/8	5 Y 6/1	Common, distinct	Silt loam; platy; oxidized root channels; gleyed ped faces
12-16	B/C	10 R 5/8	None	None	Hard Clay;platy

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils due in large part to the disturbance along the facility fence line.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range		Date 30 June 2005
Applicant / Owner United States Army – Delaware National Guard		County New Castle County
Investigator CENAB-PL-P (K. Luebke, C.Spaur)		State Delaware
Do Normal Circumstances exist on the site?	YES	Community ID PFO (PEM inclusion) Wetland
Is the site significantly disturbed (Atypical Situation)?	YES	Transect ID Wetland Polygon D.
Is the area a potential Problem Area? (If needed, explain on reverse)	NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 Nyssa sylvatica*	TREE	FAC
2 Sphagnum spp.	HERB		*10 Juncus tenuis*	HERB	FAC-
3 Liquidambar styraciflua	TREE	FAC	*11 Quercus palustris*	TREE	FACW
4 Acer rubrum	TREE	FAC	*12 Q. lyrata*	TREE	OBL
5 Viburnum recognitum	SHRUB	FACW-	*13 Photinia arbutifolia*	SHRUB	FAC/FACW
6 Vaccinium corymbosum	SHRUB	FACW-	*14 Graminoides*	HERB	
7			*15 Carex sp.*	HERB	
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100 %

Remarks

This area meets the basic rule for hydrophytic vegetation. Vegetation mowed into a path. Herbaceous plants on edge, sphagnum spp. In the path, and shrubs and trees extend out a little way beyond the path

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	N/A (in)
Depth to Free Water in Pit	N/A (in)
Depth to Saturated Soil	0 (only the top 2 inches is saturated) (in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☐ Sediment Deposits

☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☑ Oxidized Root Channels in Upper 12 Inches

☑ Water-Stained Leaves

☐ Local Soil Survey Data

☑ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon D

Map Unit Name (Series and Phase): Metapeake Silt Loam			Drainage Class: Well Drained		
Taxonomy (Subgroup): Typic Hapludults			Field Observations Confirm Mapped Type? No		

PROFILE DESCRIPTION (Flag W2 S-1)

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2	A	5 B 5/1	NONE	NONE	Clay loam; subangular blocky; oxidated rhizospheres
2-16	B	10 YR 5/6	5 Y 6/1	Common, distinct	Clay loam; platy; oxidized root channels; film on ped faces

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils. The mowing disturbance presumably causes excess soil compaction which in turn leads to optimal conditions for hydric soil development. Additionally, the site is adjacent a very small open water pit (POW) that has had standing water to the top at various times of the year.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range		Date 17 June 2005
Applicant / Owner United States Army – Delaware National Guard		County New Castle County
Investigator CENAB-PL-P (K. Luebke, S. Pugh)		State Delaware
Do Normal Circumstances exist on the site?	YES	Community ID PFO (PSS inclusion) Wetland
Is the site significantly disturbed (Atypical Situation)?	NO	Transect ID Wetland Polygon I.
Is the area a potential Problem Area? (If needed, explain on reverse)	NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Acer rubrum	TREE	FAC	*9 Photinia arbutifolia*	SHRUB	FACW /FAC
2 Liquidambar styraciflua	TREE	FAC	*10 Cornus racemosa*	SHRUB	NI
3 Nyssa sylvatica	TREE	FAC	*11 Quercus palustris*	TREE	FACW
4 Viburnum recognitum	SHRUB	FACW-	*12 Q. marilandica*	TREE	NI
5 Cornus amomum	SHRUB	FACW	*13 Q. bicolor*	TREE	FACW+
6 Rhus allegheniensis	HERB	FACU-	*14 Diospyros virginiana*	TREE	FAC-
7			*15 Sassafras albidum*	TREE	FACU-
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 84 %

Remarks
This area meets the basic rule for hydrophytic vegetation.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)
☐ Stream, Lake, or Tide Gauge
☐ Aerial Photographs
☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	N/A	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
☐ Inundated
☐ Saturated in Upper 12 Inches
☐ Water Marks
☐ Drift Lines
☐ Sediment Deposits
☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
☐ Oxidized Root Channels in Upper 12 Inches
☑ Water-Stained Leaves
☐ Local Soil Survey Data
☑ FAC-Neutral Test
☐ Other (Explain in Remarks)

SOILS

Wetland Polygon I

Map Unit Name (Series and Phase): Keyport Silt Loam			Drainage Class: Moderately Well Drained		
Taxonomy (Subgroup): Aquic Hapludults			Field Observations Confirm Mapped Type? No		
PROFILE DESCRIPTION (Flag SSW/RMSG S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4	A	10 YR 3/2	NONE	NONE	Sandy loam; subangular blocky; few Mn concretions
4-18	B	10 YR 5/1	7.5 YR 6/8	Common, distinct	Silt loam; subangular blocky; few & fine roots

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☑ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils. The profile contains bright mottles with a low chroma matrix within the upper 10 inches below the A horizon.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site	New Castle Rifle Range		Date 17 June 2005
Applicant / Owner	United States Army – Delaware National Guard		County New Castle County
Investigator	CENAB-PL-P (K. Luebke, S. Pugh)		State Delaware
Do Normal Circumstances exist on the site?		YES	Community ID PEM Wetland
Is the site significantly disturbed (Atypical Situation)?		YES	Transect ID Wetland Polygon H.
Is the area a potential Problem Area? (If needed, explain on reverse)		NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 fescue spp.*	HERB	
2 Juncus canadensis	HERB	FACW+	*10*		
3 Scirpus spp. (no flower yet)	HERB		*11*		
4			*12*		
5			*13*		
6			*14*		
7			*15*		
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks
This area meets the basic rule for hydrophytic vegetation. The area has been recently mowed. Vehicle ruts and earth moving/clearing activity noticeable.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)
☐ Stream, Lake, or Tide Gauge
☐ Aerial Photographs
☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	0 (ponded during 3 seasons – less summer) (in)
Depth to Free Water in Pit	N/A (in)
Depth to Saturated Soil	N/A (in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:
☐ Inundated
☐ Saturated in Upper 12 Inches
☐ Water Marks
☐ Drift Lines
☑ Sediment Deposits
☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):
☐ Oxidized Root Channels in Upper 12 Inches
☐ Water-Stained Leaves
☐ Local Soil Survey Data
☑ FAC-Neutral Test
☐ Other (Explain in Remarks)

SOILS

Wetland Polygon H

Map Unit Name (Series and Phase): Keyport Silt Loam				Drainage Class: Moderately Well Drained	
Taxonomy (Subgroup): Aquic Hapludults			Field Observations Confirm Mapped Type? No		
PROFILE DESCRIPTION (Flag PEM S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-12+	A	2.5 YR 6/2	10 YR 6/6	Common, distinct	Clay loam; subangular blocky;

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils. The profile contains bright mottles with a low chroma matrix within the upper 10 inches or below the A horizon (whichever is shallower).

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site	New Castle Rifle Range	Date	30 June & 29 July 2005
Applicant / Owner	United States Army – Delaware National Guard	County	New Castle County
Investigator	CENAB-PL-P (K. Luebke, C. Spaur, H. Wells)	State	Delaware
Do Normal Circumstances exist on the site?	YES	Community ID	PEM Wetland
Is the site significantly disturbed (Atypical Situation)?	YES	Transect ID	Emergent Wetland (X)
Is the area a potential Problem Area? (If needed, explain on reverse)	NO	Plot ID	-

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 Eleocharis tenuis*	HERB	FACW+
2 Scirpus atrovirens	HERB	OBL	*10 Ludwigia alternifolia*	HERB	FACW+
3 Carex annectens	HERB	FACW	*11 Juncus tenuis*	HERB	FAC-
4 Carex scoparia	HERB	FACW	*12 Rhyncospora macrostachys*	HERB	OBL
5 Rhexia mariana	HERB	OBL	*13 Tridens flavus*	HERB	FACU*
6 Cinna latifolia	HERB	FACW	*14 Lespedeza striata*	HERB	FACU
7 Halcus lanatus (top of rut)	HERB	FACU	*15*		
8 *Carex carolinea (top of rut)*	HERB	FACU	*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 75%

Remarks

This area meets the basic rule for hydrophytic vegetation. The area has been recently mowed. Vehicle ruts caused by reforestation activities. Hydrology may come from the nearby abandoned septic drain fields (WNW end of site). The relative dominance of Rhexia usually determined the edge of vegetation. Grasses and Linum intercusum were dominate in upland side.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS	
Depth of Surface Water	(potential seasonal sfc ponding, no field verification) (in)
Depth to Free Water in Pit	N/A (in)
Depth to Saturated Soil	N/A (in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☑ Sediment Deposits (encrusted detritus???)

☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☑ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☑ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon PEM W-X

Map Unit Name (Series and Phase): Keyport Silt Loam				Drainage Class: Moderately Well Drained	
Taxonomy (Subgroup): Aquic Hapludults			Field Observations Confirm Mapped Type? Yes		
PROFILE DESCRIPTION (PEM20 S-1)					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-4	A	10 YR 4/2		FAINT, indistinct	Clay loam; subangular blocky; oxidized rhizospheres & root channels
4-16	B	2.5 Y 7/2	7.5 YR 5/8	Common, distinct	Silt clay loam; subangular blocky; oxidized root channels

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils. The profile contains bright mottles with a low chroma matrix within the upper 10 inches or below the A horizon (whichever is shallower). Soil compaction and topographic manipulation probably has led to the surface ponding and subsequent hydric soil formation.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range	Date 17 June 2005
Applicant / Owner United States Army – Delaware National Guard	County New Castle County
Investigator CENAB-PL-P (K. Luebke, S. Pugh)	State Delaware
Do Normal Circumstances exist on the site? YES	Community ID PEM Wetland
Is the site significantly disturbed (Atypical Situation)? YES	Transect ID Wetland ditch (WD-3) in rip- rap.
Is the area a potential Problem Area? (If needed, explain on reverse) NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 Scirpus atrovirens*	HERB	OBL
2 Juncus canadensis	HERB	FACW+	*10 Typha latifolia*	HERB	OBL
3 Carex vulpinoidea	HERB	OBL	*11 Juncus tenuis*	HERB	FAC-
4			*12*		
5			*13*		
6			*14*		
7			*15*		
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. The area is a maintained (mowed/cleared) drainage ditch. WD- 1 and WD-2 are dominated by Juncus effusus (FACW+) and Juncus tenuis (FAC-).

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	N/A	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☐ Sediment Deposits

☑ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☐ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☐ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon (Wetland Ditches 1, 2 and 3)

Map Unit Name (Series and Phase): Keyport Silt Loam				Drainage Class: Moderately Well Drained	
Taxonomy (Subgroup): Aquic Hapludults			Field Observations Confirm Mapped Type? No		
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☐ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site	New Castle Rifle Range		Date 22 July 2005
Applicant / Owner	United States Army – Delaware National Guard		County New Castle County
Investigator	CENAB-PL-P (K. Luebke)		State Delaware
Do Normal Circumstances exist on the site?		YES	Community ID PEM Wetlands
Is the site significantly disturbed (Atypical Situation)?		YES	Transect ID W-J
Is the area a potential Problem Area? (If needed, explain on reverse)		NO	Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 Typha latifolia*	HERB	OBL
2 Juncus canadensis	HERB	FACW+	*10 Carex scoparia*	HERB	FACW
3			*11*		
4			*12*		
5			*13*		
6			*14*		
7			*15*		
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. The area is partially maintained by mowing. Two polygons separated by a vehicle path. Vehicle ruts in wetland have standing water. Also, the soil survey shows this to be tidal marsh so evidently fill material has been added.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	0-3	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☑ Sediment Deposits

☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☑ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☑ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon W-J

Map Unit Name (Series and Phase): Tidal Marsh, salty				Drainage Class: Very Poorly Drained	
Taxonomy (Subgroup):			Field Observations Confirm Mapped Type? No		
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-1	A	2.5 Y 5/3	5 YR 5/8	Common, distinct	Clay Loam; platy; very fine roots; oxidized root channels
1-6	B1	10 YR 7/4	5 YR 4/6	Common, distinct	Silty Clay loam; platy; friable; strong clay films on ped faces (2.5 Y 7/1)
6-16	B2	5 YR 4/6	10 YR 7/4	Common, distinct	Sandy clay loam; platy; friable

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☐ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☐ Listed on Local Hydric Soils List
- ☑ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location does not meet the basic rules for hydric soils. However, the fill material and vehicle ruts have probably skewed the soils data. Hydric soils have probably not had time enough to form completely.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

DATA FORM

ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site New Castle Rifle Range			Date 22 July 2005
Applicant / Owner United States Army – Delaware National Guard			County New Castle County
Investigator CENAB-PL-P (K. Luebke)			State Delaware
Do Normal Circumstances exist on the site?	YES		Community ID PEM Wetlands
Is the site significantly disturbed (Atypical Situation)?	YES		Transect ID W-K
Is the area a potential Problem Area? (If needed, explain on reverse)	NO		Plot ID -

VEGETATION

Dominant Plant Species	Stratum	Indicator	**Non**-Dominant Plant Species	Stratum	Indicator
1 Juncus effusus	HERB	FACW+	*9 Juncus tenuis*	HERB	FAC-
2 Carex scoparia	HERB	FACW	*10 Phragmites australis*	HERB	FACW
3 Eleocharis sp (8-10 inches)	HERB	FACW	*11 Typha angustifolia*	HERB	OBL
4			*12*		
5			*13*		
6			*14*		
7			*15*		
8			*16*		

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-) 100%

Remarks

This area meets the basic rule for hydrophytic vegetation. The area is partially maintained by mowing. Two polygons separated by a vehicle path. Vehicle ruts in wetland have standing water. Also, the soil survey shows this to be tidal marsh so evidently fill material has been added.

HYDROLOGY

☐ Recorded Data (Describe in Remarks)

☐ Stream, Lake, or Tide Gauge

☐ Aerial Photographs

☐ Other

☑ No Recorded Data Available

FIELD OBSERVATIONS

Depth of Surface Water	0-3	(in)
Depth to Free Water in Pit	N/A	(in)
Depth to Saturated Soil	N/A	(in)

WETLAND HYDROLOGY INDICATORS

Primary Indicators:

☐ Inundated

☐ Saturated in Upper 12 Inches

☐ Water Marks

☐ Drift Lines

☑ Sediment Deposits

☐ Drainage Patterns in Wetlands

Secondary Indicators (2 or more Required):

☑ Oxidized Root Channels in Upper 12 Inches

☐ Water-Stained Leaves

☐ Local Soil Survey Data

☑ FAC-Neutral Test

☐ Other (Explain in Remarks)

SOILS

Wetland Polygon W-K

Map Unit Name (Series and Phase): Elkton Silt Loam				Drainage Class: Poorly Drained	
Taxonomy (Subgroup): Typic Endoaquults			Field Observations Confirm Mapped Type? Yes		
PROFILE DESCRIPTION					
Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2	A	5 Y 6/2	N/A	NONE	Silty clay loam; very fine roots; oxidized root channels; saturated
2-8	B1	5 Y 7/1	7.5 Y 5/8	Common, distinct	Silt clay loam; platy; friable; very fine roots; oxidized root channels
8-16	B2	5 Y 7/1	7.5 Y 5/8	Common, distinct	Silt clay loam; platy; friable;

HYDRIC SOIL INDICATORS:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Aquic Moisture Regime
- ☐ Reducing Conditions
- ☑ Gleyed or Low-Chroma Colors
- ☐ Concretions
- ☐ High Organic Content in Surface Layer in Sandy Soils
- ☐ Organic Streaking in Sandy Soils
- ☑ Listed on Local Hydric Soils List
- ☑ Listed on National Hydric Soils List
- ☐ Other (Explain in Remarks)

Remarks:

This location meets the basic rules for hydric soils. This profile is within the accepted range for this soil series.

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	YES	Is this Sampling Point Within a Wetland? YES
Wetland Hydrology Present?	YES	
Hydric Soils Present?	YES	

Remarks

The three wetland criteria are met.

SURFACE WATER PLS

The RRTS is located in the Army Creek watershed, in the Delaware Bay drainage basin, as defined by the Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Water Resources (DNREC, 1998). The larger scale watershed definition used by the US Environmental Protection Agency (USEPA) considers the same region to be in the Delaware Bay watershed (USGS Cataloging Unit: 02040204), which includes the Delaware River and 18 other major surface waters in Delaware, New Jersey, and Pennsylvania (USEPA, 1998).

The RRTS is located in the upper estuary of the Delaware River, and is highly influenced by the dynamics of the estuarine system. Tidal creeks, such as Gambles Gut on the northern perimeter of the installation, are significant surface features that connect the property to the Delaware River. The Delaware River forms the eastern boundary of the RRTS and is the site's most significant surface water feature. The Delaware River is approximately 2 miles wide at this location. The depth of the river reaches about 40 feet in the shipping channel near the RRTS (DRKN, 1999). The RRTS is located along the river's tidal segment, where salinity ranges from fresh to slightly brackish. The Delaware River watershed encompasses 12,765 square miles of land in New York, New Jersey, Pennsylvania, and Delaware (DRKN, 1999).

Water quality problems in the Delaware River are the result of both historical and current pressures from industry, agriculture, and population. The Delaware River Basin Commission (DRBC) monitors water quality from the headwaters to the estuary and has divided the river and bay into six segments. The tidal segment that includes the RRTS is designated as Zone 5, which along with Zone 6 constitutes the Delaware Estuary and Bay.

For 1996-1997, approximately 59 mi^2 of the 841 mi^2 estuary and bay (Zones 5 and 6) were impaired by low dissolved oxygen and chronic toxicity, as a result of pollution from point sources. Low dissolved oxygen levels were found for water samples taken at and in the vicinity of New Castle, with the lowest value of 2.9 milligrams per liter (mg/l) recorded at nearby Pea Patch Island. The minimum dissolved oxygen standard based on a 24-hour average concentration is 6.0 mg/l (DRBC, 1998). The DRBC has addressed toxic pollutants in the tidal Delaware River by adopting water quality criteria and implementation procedures for a Total Maximum Daily Load (TMDL), focusing on point source pollutant discharges. Non-point source discharges will be addressed by Phase 2 of this two-phased approach. Water quality in the Delaware Estuary is addressed by the Comprehensive Conservation Management Plan of the Delaware Estuary Program (DRBC, 1998).

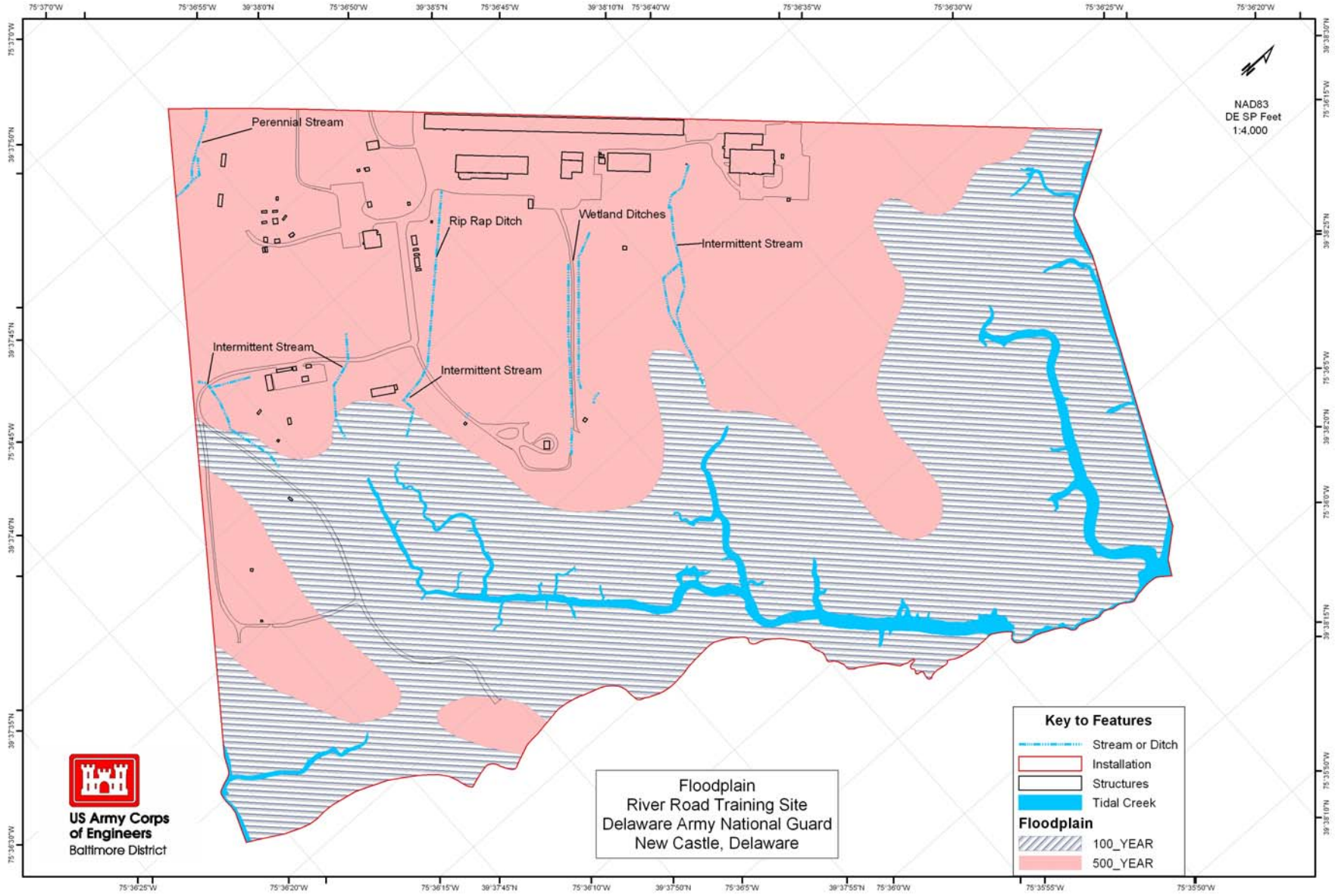
Delaware's second most significant surface water feature, the Chesapeake and Delaware Canal, is located approximately six and a half miles south of the RRTS. Surface water runoff at the RRTS drains to the salt marshes to the north and south and the river to the east through drainage ditches. After heavy rainfalls, ponding of surface water tends to occur in several low-lying mowed areas (WRA, Inc. 1995a).

Clean Water Act and Related State Regulations

The Federal Water Pollution Control Act (FWPCA) of 1972 (33 USC 1251 *et seq*.), as amended by the Clean Water Act (CWA) and the Water Quality Act of 1987, forms the legal framework to support maintenance and restoration of water quality. The FWPCA establishes the National

Pollutant Discharge Elimination System (NPDES) as the regulatory mechanism to achieve water quality goals by regulating pollutant discharge to navigable streams, rivers, and lakes. The WQA places emphasis on best management practices, monitoring and control of toxic constituents in wastewater, permitting of outfalls composed entirely of stormwater, and regulations governing sewage sludge disposal. The RRTS has prepared a Stormwater Pollution Prevention Plan (SWP3) in accordance with the regulatory requirement of the Army National Guard Environmental Compliance Assessment System (ECAS Requirement 2-15). The SWP3 addresses the requirement stating that stormwater discharge should be uncontaminated and periodically monitored, although the discharge is not covered by an NPDES permit.

State policy regarding water resources is addressed in Chapter 39 of the Delaware State Code (44 Del. Laws, c. 212, § 2; 7 Del. C. 1953, § 3901; 54 Del. Laws, c. 188, § 2; 55 Del. Laws, c. 456, § 1.). The development, use, and preservation of water resources in the state of Delaware fall under the jurisdiction of Soil and Water Conservation Districts administered by DNREC.



SURFACE WATER FEATURES AT THE RIVER ROAD TRAINING SITE

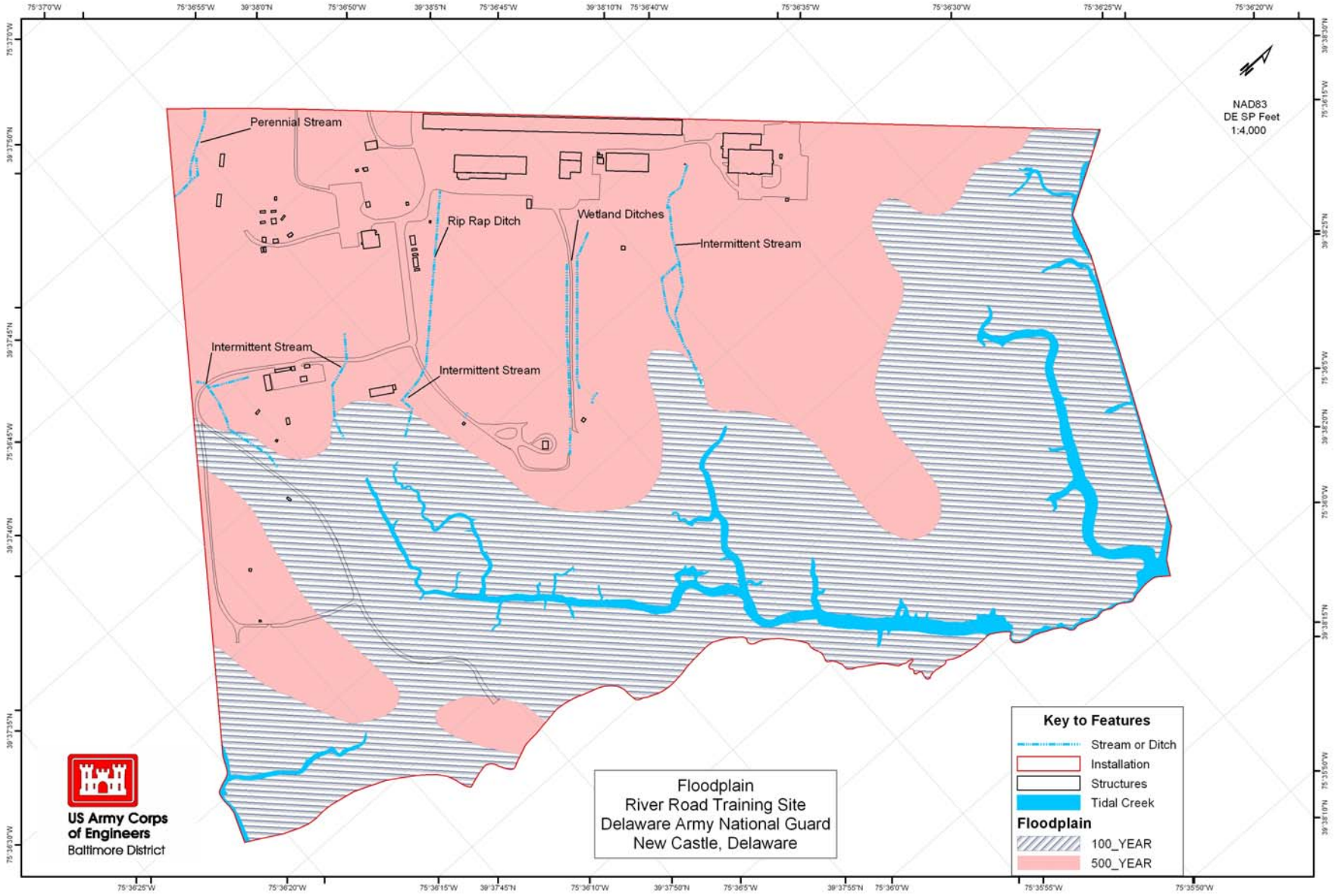
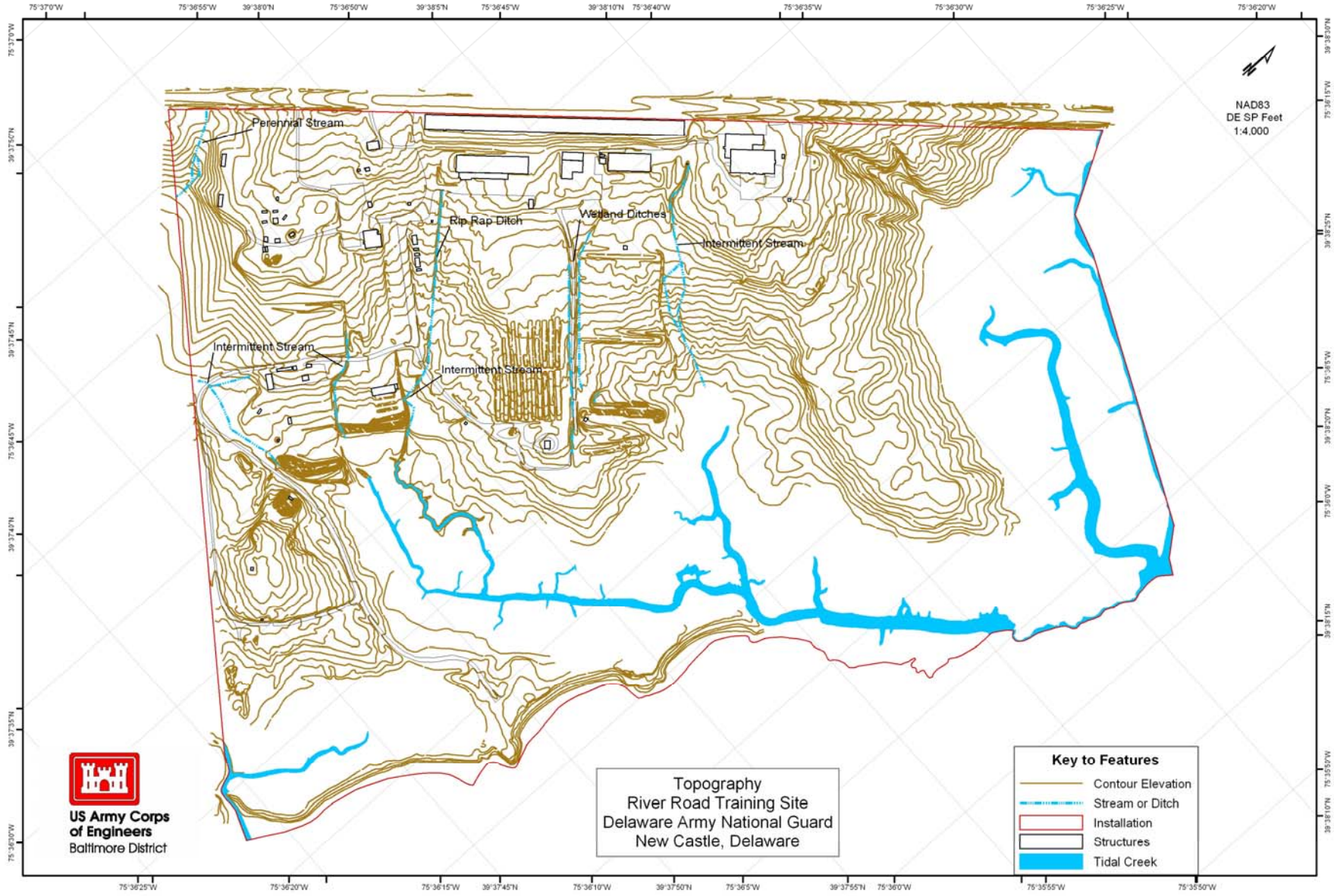


FIGURE 4-4: FLOODPLAINS AT THE RIVER ROAD TRAINING SITE

TOPOGRAPHY PLS

The RRTS is in the Coastal Plain physiographic region. The predominant landform consists of a flat, weakly dissected alluvial plain formed by deposition of continental sediments onto submerged, shallow continental shelf, which was later exposed by sea level subsidence. Along the coast, fluvial deposition and shore zone processes are active in developing and maintaining beaches, swamps, and mud flats.

The terrain at the RRTS itself undulates between elevations of 10 feet and 30 feet above mean sea level (MSL) over the majority of the property, decreasing eastward to elevations of less than 5 feet above MSL. Runoff from the installation flows into brackish marshes to the north and south, and into the Delaware River to the east, with the majority of the building area draining east through ditches.



TOPOGRAPHY AT THE RIVER ROAD TRAINING SITE

SOILS PLS

Geological Context of Soils at the RRTS

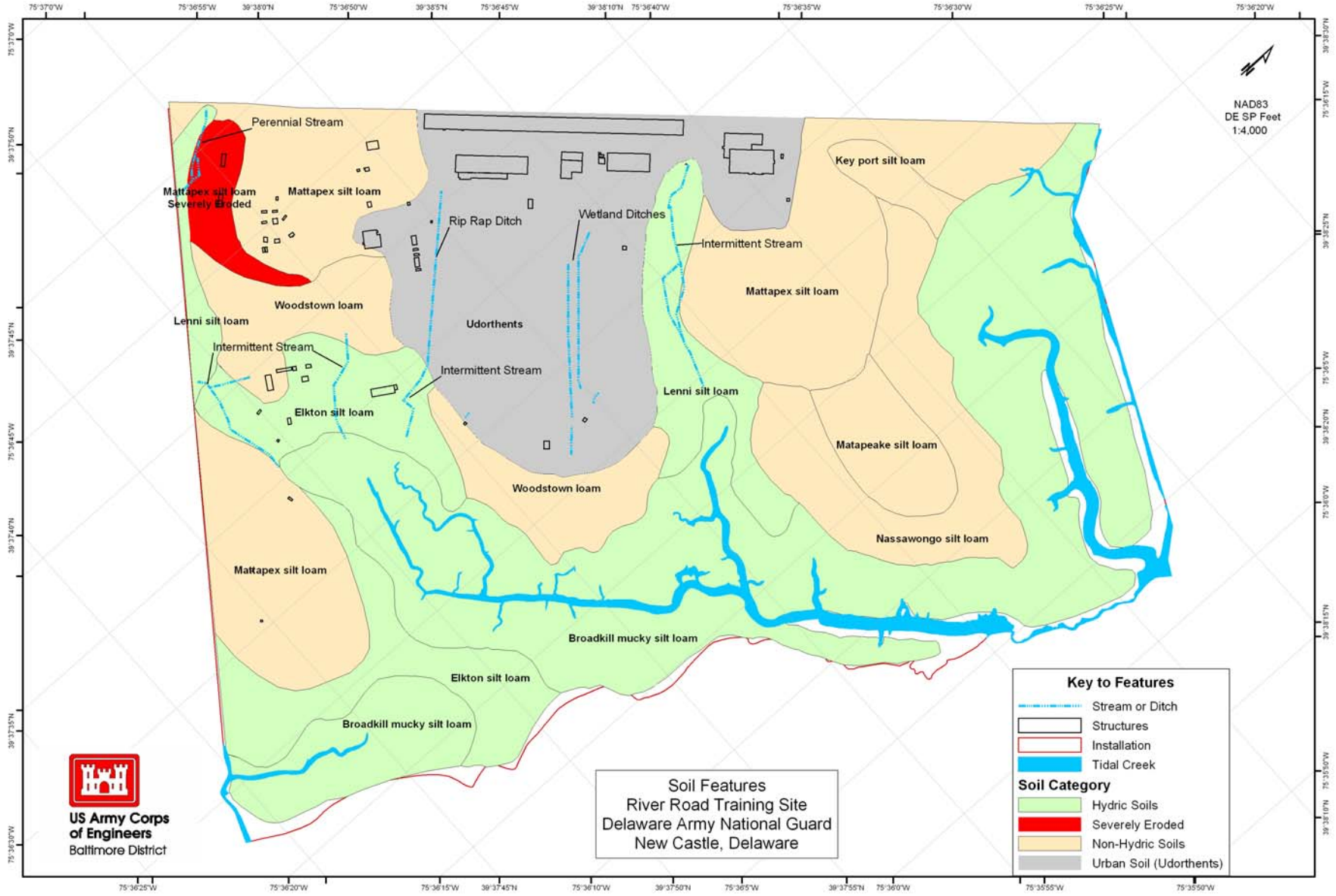
The RRTS is located in the Atlantic Coastal Plain geologic province, which consists of a seaward-thickening wedge of semi-consolidated to unconsolidated sediments above a crystalline basement. However, the dominant geological unit at the installation is the Potomac Formation. This formation is fluvial in origin, and is composed predominantly of clays and silts with some interbedded sands. It is approximately 500 feet thick at the RRTS, thickening towards the southeast to approximately 1,300 feet in southern New Castle County. The top of the formation is about 10 feet below the land surface at the site, deepening gradually toward the southeast. Piedmont crystalline bedrock underlies the Potomac Formation at a depth of approximately 500 feet below MSL. The sediments of the Columbia Formation cover much of the Potomac Formation, consisting of poorly sorted fluvial sands with some interbedded gravels, silts, and clays. The Columbia Formation is of relatively consistent thickness throughout the region. The continuity of clayey layers above the water table is not known (DEARNG, 1995).

Soils at the RRTS

Based on the Natural Resources Conservation Service soil surveys and mapping conducted at the RRTS during 2000, 10 soil series occur on the RRTS. Five of these soil series were not previously identified in the 1974 edition of the USDA Soil Conservation Service (SCS 1974) Soil Survey Manual. Those five series are: 1) Broadkill (formerly identified as Tidal Marsh), 2) Woodstown, 3) Mattapex, 4) Nassawango (formerly mapped as Metapeake), and Lenni (formerly mapped as Johnstown). As shown in Figure 2-3, the following soil types are found at the RRTS:

SOILS ON THE RRTS

Soil Unit Name	Slopes (percent)	Symbol	Drainage Class	Prime Farmland (Federal or State)	Hydric	Acres on the RRTS
Broadkill Mucky Silty Clay Loam	0 to 2		Very Poorly Drained	No	Yes	58.47
Elkton Silt Loam	0 to 2	EmA	Poorly Drained	State	Yes	8.71
Elkton Silt Loam	2 to 5	EmB	Poorly Drained	State	Yes	7.34
Keyport Silt Loam	0 to 2	KeA	Moderately Well Drained	State	Yes	1.83
Lenni Silt Loam	0 to 2		Poorly Drained	No	No	8.58
Matapeake Silt Loam	0 to 2	MeA	Well Drained	Federal	No	4.59
Mattapex Silt Loam, moderately eroded	2 to 5	MtB2	Moderately Well Drained	Federal	No	35.84
Mattapex Silt Loam, severely eroded	5 to 10	MtC3	Moderately Well Drained	No	No	2.66
Nassawango Silt Loam	2 to 5		Well Drained	No	No	11.92
Udorthents	0 to 10		Undefined	No	No	33.25
Woodstown Loam, Moderately Eroded	2 to 5	WsB2	Moderately Well Drained	Federal	No	11.26
Source: USDA Soil Data Mart, http://soildatamart.nrcs.usda.gov/Report.aspx?Survey=DE003&UseState=DE						



SOILS AND SOIL FEATURES AT THE RIVER ROAD TRAINING SITE

The majority of the upland portion of the RRTS consists of Udorthents. The Udorthents are located on anthropogenic fill material sites. There are no foreseeable management implications concerning the Udorthents soil type.

Hydric Soils:

Four soil mapping units designated as hydric are found on the RRTS: Broadkill Mucky, Silty Clay Loam, 0 to 2 percent slopes; Elkton Silt Loam, 0 to 2 percent slopes; Elkton Silt Loam, 2 to 5 percent slopes; and Lenni Silt Loam, 0 to 2 percent slopes. Hydric soils are soils that are saturated, flooded, or ponded for long enough during the growing season to develop anaerobic (oxygen- deficient) conditions in their upper part. Anaerobic soil conditions are conducive to the establishment of vegetation that is adapted for growth underoxygen-deficient conditions and is typically found in wetlands (hydrophytic vegetation).

Approximately 83.1 acres (43.7 percent) of the RRTS lies on hydric soils. Approximately 62.7 acres of these hydric soil areas are within wetlands. Whether or not the hydric soils are located in jurisdictional wetlands, they represent potential engineering, construction and management constraints. Hydric soils are generally characterized as either having a slow permeability or poor to very poor drainage class. The presence of hydric soils is one of three criteria (hydric soils, hydrophytic vegetation, wetland hydrology) used to determine the presence of USACE jurisdictional wetlands (USDA, 1970). By regulatory wetland definition, all of the RRTS wetlands identified during the wetland delineation occur on hydric soils even though those soils may not have mapped as such in the past. Streams at the RRTS also flow through hydric soils (Lenni, Elkton and Broadkill).

HYDRIC SOILS ON THE RRTS

SOIL UNIT NAME	SLOPES (PERCENT)	SYMBOL	DRAINAGE CLASS	ACRES ON THE RRTS
Broadkill Mucky Silty Clay Loam	0 to 2		Very Poorly Drained	58.47
Elkton Silt Loam	0 to 2	EmA	Poorly Drained	8.71
Elkton Silt Loam	2 to 5	EmB	Poorly Drained	7.34
Lenni Silt Loam	0 to 2		Moderately Well Drained	8.58
TOTAL ACREAGE				**83.1**

Prime Farmland Soils:

As shown in the tables below, six soils that occur on the RRTS are considered to be of quality that matches specifications for prime farmland soils or farmland soils of statewide importance. Prime farmland soils are defined as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well-managed soil to produce a sustained high yield of crops in an economic manner. The land could be cropland, pasture, rangeland, or other land, but not urban built-up land or water. A farmland soil of statewide importance includes land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, and oilseed crops. Criteria for defining and delineating this land are determined by the appropriate state agency or agencies. prime farmland soils are protected under the Farmland Protection Policy Act (FPPA) of 1981.

The intent of the act is to minimize the extent to which federal programs contribute to the unnecessary or irreversible conversion of farmland soils to nonagricultural uses. The act also ensures that federal programs are administered in a manner that, to the extent practicable, will be compatible with private, state, and local government programs and policies to protect farmland. The NRCS is responsible for overseeing compliance with the FPPA and has developed the rules and regulations for implementation of the act (see 7 CFR Part 658, July 5, 1984). It should be noted, however, that although these soils match the quality of prime farmland soils, the designation of prime farmland soils and protection measures do not apply to DOD installations.

PRIME FARMLAND SOILS ON THE RRTS (FEDERALLY LISTED)

SOIL UNIT NAME	SLOPES (PERCENT)	SYMBOL	DRAINAGE CLASS	ACRES ON THE RRTS
Matapeake Silt Loam	0 to 2	MeA	Well Drained	4.59
Mattapex Silt Loam, moderately eroded	2 to 5	MtB2	Moderately Well Drained	35.84
Woodstown Loam, Moderately Eroded	2 to 5	WsB2	Moderately Well Drained	11.26
TOTAL ACREAGE				**51.69**

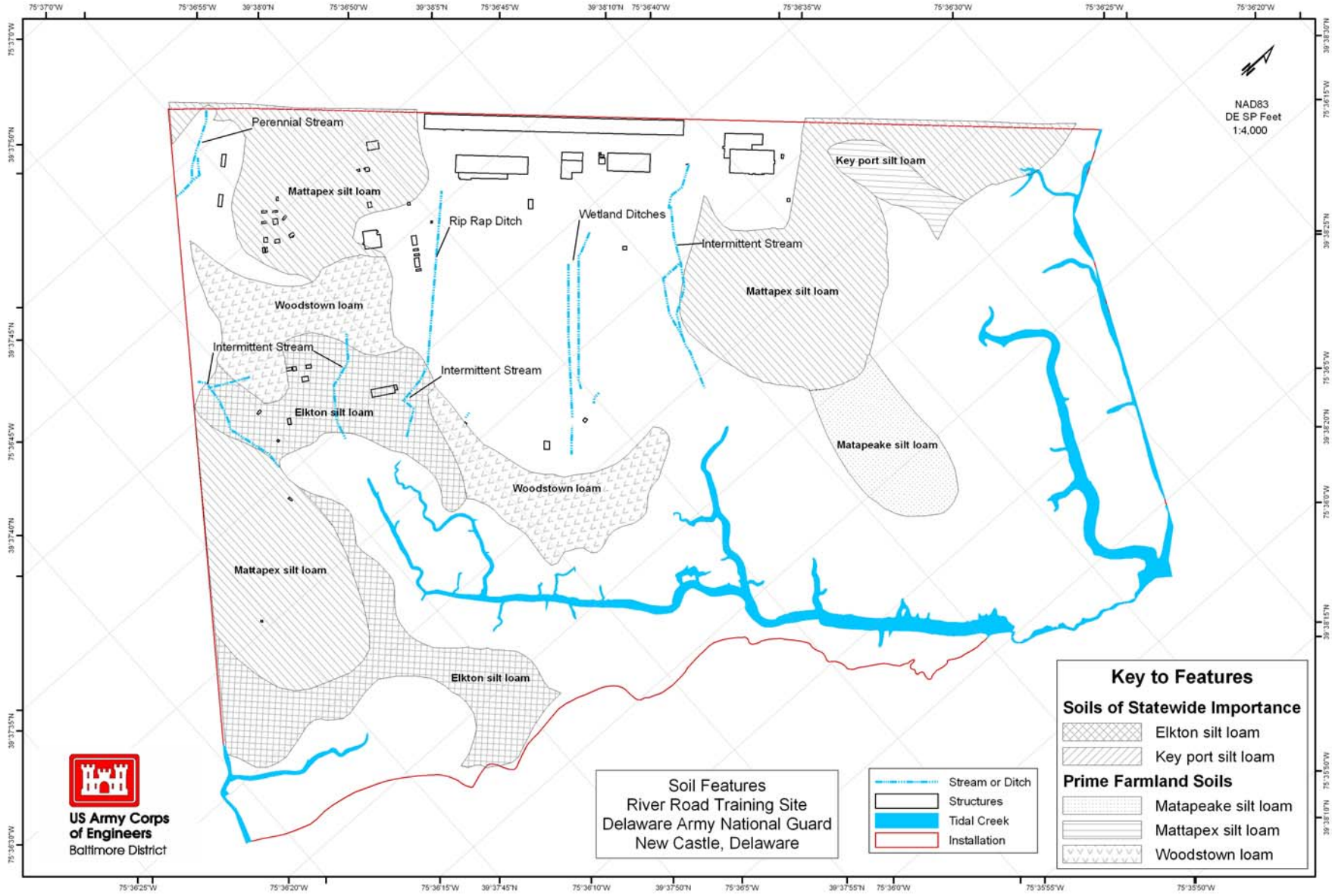
SOILS OF STATEWIDE IMPORTANCE ON THE RRTS

SOIL UNIT NAME	SLOPES (PERCENT)	SYMBOL	DRAINAGE CLASS	ACRES ON THE RRTS
Elkton Silt Loam	0 to 2	EmA	Poorly Drained	8.71
Elkton Silt Loam	2 to 5	EmB	Poorly Drained	7.34
Keyport Silt Loam	0 to 2	KeA	Moderately Well Drained	1.83
TOTAL ACREAGE				**17.88**

Highly Erodible Soils

Perennial stream number 7, located in the northwest corner of the installation, flows through the portion of Mattapex silt loam (5 to 10 percent slope) soil type designated as severely eroded. A headcut exists in the middle to upper reach of stream number 7 and is indicative of excessive erosion. Special management consideration should be given to the Mattapex silt loam area identified as severely eroded.

The soils in the draws in which runoff is carried represents a unique concern to the RRTS. On site and off site development may increase the amount of runoff flowing to soils that would have otherwise been naturally stable.



PRIME FARMLAND SOILS AND SOILS OF STATEWIDE IMPORTANCE AT THE RIVER ROAD TRAINING SITE

OFFICIAL SOILS SERIES DESCRIPTIONS

LOCATION BROADKILL DE+MD NJ
Established Series
CDP-PK/Rev. JAK
11/2002

BROADKILL SERIES

MLRA(s): 149A, 153C, 153D
MLRA Office Responsible: Raleigh, North Carolina
Depth Class: Very deep
Drainage Class (Agricultural): Very poorly drained
Index Surface Runoff: Negligible
Internal Free Water Occurance: Very shallow; Permanent
Permeability: Moderate or moderately slow above 40 inches and variable below 40 inches
Parent Material: Loamy marine sediments, high in silt
Slope: 0 to 2 percent
Mean Annual Air Temperature (type location): 57 degrees F.
Mean Annual Precipitation (type location): 44 inches

TAXONOMIC CLASS: Fine-silty, mixed, active, nonacid, mesic Typic Sulfaquents

TYPICAL PEDON: Broadkill mucky peat--salt marsh. (Colors are for a moist soil).

Oe--0 to 6 inches; very dark grayish brown (2.5Y 3/2) mucky peat (hemic soil materials); 60 percent herbaceous fibers, 25 percent rubbed; 34 percent organic material; many very fine, fine, and medium and common coarse roots (70 percent of volume is a dense mat of live roots and stems); electrical conductivity 26.2 mmhos/cm; neutral (pH 6.6), ultra acid (pH 2.9) after moist incubation; clear smooth boundary. (0 to 7 inches thick).

Ag--6 to 13 inches; dark gray (5Y 4/1) and very dark gray (5Y 3/1) silty clay loam; massive; friable; slightly sticky, slightly plastic; many fine or medium and common coarse roots; electrical conductivity 27.3 mmhos/cm; n-value greater than 1.0, material flows easily between the fingers when squeezed; neutral (pH 6.8), ultra acid (pH 3.4) after moist incubation; gradual smooth boundary. (0 to 12 inches thick)

Cg1--13 to 32 inches; dark gray (5Y 4/1) and dark olive gray (5Y 3/2) silty clay loam; massive; friable; slightly sticky, slightly plastic; common very fine and fine and few medium roots; electrical conductivity 26.7 mmhos/cm; n-value greater than 1.0, material flows easily between the fingers when squeezed; neutral (pH 6.8), extremely acid (pH 4.3) after moist incubation; clear smooth boundary.

Cg2--32 to 38 inches; dark olive gray (5Y 3/2) silt loam; massive; friable; slightly sticky, slightly plastic; common fine and few medium roots; electrical conductivity 29.5 mmhos/cm; n-value greater than 1.0, material flows easily between the fingers when squeezed; neutral (pH 6.6), strongly acid (pH 5.2) after moist incubation; diffuse smooth boundary.

Cg3--38 to 80 inches; very dark gray (5Y 3/1) silt loam; massive; friable; slightly sticky, slightly plastic; few fine and medium roots; electrical conductivity 32.7 mmhos/cm; n-value greater than 1.0, material flows easily between the fingers when squeezed; neutral (pH 6.7), moderately acid (pH 5.6) after moist incubation.

TYPE LOCATION: Sussex County, Delaware; about 400 feet east and 600 feet south of the junction of County Road 264 and the Broadkill River; lat. 38 degrees 48 minutes 02 seconds N. and long. 75 degrees 12 minutes 08 seconds W.

RANGE IN CHARACTERISTICS:
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: +12 to 0 inches, January to December and continuously saturated with water and flooded twice daily by tides
Depth to Underlying Organic layers: Greater than 40 inches
Rock Fragments: absent in the upper 40 inches, 0 to 5 percent, by volume below 40 inches
Electrical Conductivity: Greater than 16 mmhos/cm
Soil Reaction: Slightly acid to slightly alkaline, throughout the profile, after moist incubation, ultra acid or extremely acid within 20 inches of the surface
Other Features: Many pedons, once exposed, form jarosite mottles. The n-value to a depth of 40 inches is 0.7 or more. Below 40 inches it is variable.

RANGE OF INDIVIDUAL HORIZONS:
O horizon:
Color--hue of 7.5YR to 5Y, value of 2 to 4, and chroma of 1 or 2
Texture--mucky peat or peat (commonly, over 60 percent of the soil volume consists of live roots and stems)

Ag horizon:
Color--hue of 5YR to 5BG, value of 2 to 4, and chroma of 1 or 2, or is neutral with value of 2 to 4
Texture--silt loam, silty clay loam, or silty clay, including the mucky texture modifier
Organic Matter Content: 2 to 12 percent

Cg horizon:
Color--hue of 5YR to 5BG, value of 2 to 7, and chroma of 1 or 2, or is neutral with value of 2 to 7
Texture (above of 40 inches)--silt loam or silty clay loam and may contain thin lenses of organic or coarse-textured soil materials
Texture (below 40 inches)--silty clay loam, silt loam, loam, sandy loam, loamy sand, or sand

COMPETING SERIES: None

GEOGRAPHIC SETTING:
Landscape: Coastal Plain marshes
Landform: Estuarine tidal salt marshes--flooded twice daily by tides and occasionally by storm surges
Elevation: 0 to 2 feet
Parent Material: Loamy marine sediments, high in silt
Mean Annual Air Temperature: 52 to 58 degrees F.

Mean Annual Precipitation: 36 to 55 inches
Frost Free Period: 175 to 200 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Appoquinimink soils--have within 40 inches of the soil surface organic layers more than 8 inches thick, on similar landforms
Boxiron soils--have a histic epipedon, on similar landforms
Pawcatuck soils--organic sols with organic layers 16 to 51 inches thick, underlain by sandy mineral layers, on similar landforms
Transquaking soils--organic sols with organic layers more than 51 inches thick, underlain by loamy mineral layers, on similar landforms
Westbrook soils--organic sols with organic layers 16 to 51 inches thick, underlain by loamy mineral layers, on similar landforms

DRAINAGE AND PERMEABILITY:
Drainage Class (Agricultural): Very poorly drained
Index Surface Runoff: Negligible
Internal Free Water Occurance: Very shallow; Permanent
Permeability: Moderate or moderately slow above 40 inches and variable below 40 inches

USE AND VEGETATION:
Major Uses: Primarily as wetland wildlife--shellfish and small crustacean habitat. Large areas in Delaware have been ditched to provide better drainage for mosquito control. Some areas were previously filled to provide waterfront homesites.
Dominant Vegetation: The natural vegetation is salt-tolerant wetland species, predominantly salt marsh cordgrass, salt hay, salt wort, and spike grass.

DISTRIBUTION AND EXTENT:
Distribution: Coastal areas of Delaware, Maryland, New Jersey.
Extent: Moderate

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Worcester County, Maryland, 1995.

REMARKS: Broadkill soils were formerly mapped as Tidal Marsh miscellaneous areas. They become extremely acid when drained.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Hemic soil materials--the zone from 0 to 6 inches has a fiber content, after rubbing, that is one-sixth to two-fifths of the soil volume
Ochric epipedon--the zone from the soil surface to a depth of 13 inches (Oe and Ag horizons)
Peraquic conditions--the zone from the soil surface to a depth of 80 inches is continuously saturated (endosaturation).
High n-value--the zone from the surface to 80 inches has n-value greater than 0.7 typically greater than 1.0.
Sulfidic materials--incubated samples, to a depth of 80 inches, show a drop in pH of 0.5 or more units to a pH value of 4.0 or less within 8 weeks

SERIES INTERPRETATION RECORDS(S): DE0010

ADDITIONAL DATA: None

TABULAR SERIES DATA:
SOI5 Soil Name Slope Airtemp FrFr/Seas Precip Elevation
DE0010 BROADKILL 0-2 52- 58 175-200 36-55 0-2

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
DE0010	FREQ		+1.0-0.0	APPARENT	JAN-DEC	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
DE0010	0- 6	MPT PEAT	0- 0	-	0- 0	250-420
DE0010	0- 6	MK-SIL	0- 0	100-100	14-18	250-420
DE0010	0- 6	SICL MK-SICL SIC	0- 0	100-100	30-40	250-580
DE0010	6-38	SIL SICL	0- 0	100-100	25-35	130-260
DE0010	38-72	SR SICL S	0- 0	75-100	5-30	20-200

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
DE0010	0- 6	6.1- 7.8	20-40	16-32	2.0- 20	LOW
DE0010	0- 6	6.1- 7.8	5.-15	16-32	0.6- 2.0	LOW
DE0010	0- 6	6.1- 7.8	3.-18	16-32	0.2- 2.0	MODERATE
DE0010	6-38	6.1- 7.8	2.-10	16-32	0.2- 2.0	MODERATE
DE0010	38-72	6.1- 7.8	.5-20	16-32	0.2- 20	LOW

National Cooperative Soil Survey
U.S.A.

LOCATION ELKTON MD+DE NJ VA
Established Series
JEB/Rev. JAK
11/2002

ELKTON SERIES

MLRA(S): 148, 149A, 153B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Poorly drained
PERMEABILITY: Slow in the solum and moderately slow to rapid in the substratum
SURFACE RUNOFF: Slow to ponded
PARENT MATERIAL: Silty eolian material underlain by loamy alluvial or marine sediments
SLOPE: 0 to 2 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 56 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 45 inches

TAXONOMIC CLASS: Fine-silty, mixed, active, mesic Typic Endoaquults

TYPICAL PEDON: Elkton silt loam, on a smooth 0 percent slope in woodland. (Colors are for a moist soil.)

Oi/Oe--0 to 3 inches; undecomposed and partially decomposed leaves and twigs from loblolly pine; abrupt smooth boundary. (0 to 5 inches thick)

A--3 to 4 inches; dark olive gray (5Y 3/2) silt loam; weak fine granular structure; very friable; slightly sticky, slightly plastic; many very fine, common fine and medium, and few coarse roots; many very fine and few fine and medium random tubular pores; very strongly acid; clear smooth boundary. (1 to 4 inches thick)

Eg--4 to 9 inches; gray (5Y 6/1) silt loam; weak medium subangular blocky structure parting to weak coarse granular; friable; slightly sticky, slightly plastic; common fine, and few medium and coarse roots; many very fine, and few fine and medium random tubular pores; extremely acid; clear wavy boundary. (0 to 7 inches thick)

BEg--9 to 13 inches; gray (5Y 5/1) silt loam; moderate coarse blocky and subangular blocky structure; firm; moderately sticky, moderately plastic; common fine, and very fine roots; common very fine, and few fine random tubular pores; few prominent clay films on faces of peds and lining soil pores and root channels; common coarse prominent yellowish brown (10YR 5/4) irregularly shaped iron accumulations; extremely acid; gradual wavy boundary. (0 to 6 inches thick)

Btg1--13 to 27 inches; gray (5Y 6/1) silty clay loam; strong medium and coarse blocky structure; firm; sticky, plastic; few fine roots; common very fine, and few fine random tubular pores; common prominent clay films on faces of peds and lining soil pores; common coarse prominent

strong brown (7.5YR 5/8) irregularly shaped iron accumulations; extremely acid; diffuse boundary.

Btg2--27 to 43 inches; gray (N 5/0) silty clay loam; weak thick platy structure parting to strong coarse blocky; firm; very sticky, moderately plastic; few fine roots; common very fine, and few fine random tubular pores; common prominent clay films on faces of peds and lining soil pores; common coarse prominent strong brown (7.5YR 5/6) irregularly shaped iron accumulations; very strongly acid; clear smooth boundary. (Combined thickness of the Btg horizon is 20 to 45 inches.)

2BCg--43 to 68 inches; gray (5Y 5/1) very fine sandy loam; massive; friable; slightly sticky, slightly plastic; common medium distinct yellowish brown (10YR 5/4) irregularly shaped iron accumulations; very strongly acid.

TYPE LOCATION: Dorchester County, Maryland; approximately 6.0 miles west of Cambridge, 0.5 mile west of Lloyds, about 40 feet into woods north of Rt. 343: lat. 38 degrees 35 minutes 32 seconds N. and long. 76 degrees 11 minutes 32 seconds W.

RANGE IN CHARACTERISTICS:
Solum Thickness: Greater than 40 inches
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: 0 to 12 inches, November to May
Depth to Lithologic Discontinuity: 30 inches or more
Rock Fragments: 0 to 5 percent, by volume throughout the profile, mostly fine pebbles
Soil Reaction: Extremely acid to strongly acid, throughout the profile, unless limed
Other Features: Averages 27 to 35 percent clay in the particle-size control section

RANGE OF INDIVIDUAL HORIZONS:
A horizon:
Color--hue of 10YR to 5Y, value of 3 to 6, chroma of 1 to 3, or is neutral with value of 3 to 6
Texture--silt loam, mucky silt loam, or loam

Eg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 or 2
Texture--silt loam

Btg horizon:
Color--hue of 10YR to 5GY, value of 4 to 7, and chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--silt loam, silty clay loam, or silty clay

Cg horizon (if it occurs):
Color--hue of 10YR to 5GY, value of 4 to 7, and chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--silt loam, silty clay loam, silty clay, or clay

2Ab horizon (if it occurs):
Color--hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 to 3, or is neutral with value of 4 to

7
Texture--sandy loam, fine sandy loam, or loam

2BCg horizon:
Color--hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--very fine sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam

2Cg horizon (if it occurs is at depths greater than 40 inches):
Color--hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--sand, fine sand, loamy sand, loamy fine sand, very fine sandy loam, fine sandy loam, loam, sandy clay loam, or clay loam

COMPETING SERIES:
Knowlton soils--formed in strongly acid alluvium derived from soils formed in black fissile shale, sandstone, siltstone, gray shale, limestone and dolomite
Othello soils--poorly drained mineral soils that have a fine-silty particle-size control section with 18 to 27 percent clay and sola less than 40 inches thick, on higher landforms

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Low-lying uplands, lowlands, and ancient floodplains
Elevation: 2 to 200 feet
Parent Material: Silty eolian material underlain by loamy alluvial or marine sediments
Mean Annual Air Temperature: 52 to 58 degrees F.
Mean Annual Precipitation: 42 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Othello soils--poorly drained mineral soils that have a fine-silty particle-size control section with 18 to 27 percent clay and sola less than 40 inches thick, on higher landforms
Fallsington soils--have a fine-loamy particle-size control section, on similar landforms
Leonardtown soils--have a fragipan, on similar landforms
Honga soils--very poorly drained and have organic materials at a depth of 16 to 51 inches, on lower-lying landforms
Kentuck soils--very poorly drained and have an umbric epipedon, on lower-lying landforms
Keyport soils--moderately well drained and have a fine particle-size control section, on higher landforms
Mattapex soils--moderately well drained, on higher landforms

USE: Mostly woodland. Adequately drained areas are cropped to corn, soybeans, and small grain crops. Some areas are grazed, but there is little improved pasture.

VEGETATION: Native vegetation in the overstory is red maple, sweetgum, willow oak, blackgum, and loblolly pine. Common understory species are greenbrier, American holly, waxmyrtle, and sweetbay.

DISTRIBUTION: Coastal Plain of Maryland, Delaware, and New Jersey

EXTENT: Moderate

SERIES ESTABLISHED: Cecil County, Maryland, 1900

REMARKS: These soils were previously classified as having a clayey particle-size control section.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the soil surface to a depth of 10 inches (A, Eg, and BEg horizons)
Argillic horizon--the zone from 10 to 40 inches (Btg1 and Btg2 horizons)
Aquic conditions--the zone from the soil surface to a depth of 80 inches is continuously saturated (endosaturation)

SERIES INTERPRETATION RECORD(S): MD0052, MD0151 (VERY WET)

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
MD0052	ELKTON	0- 5	52- 58	190-210	42- 48	2- 200
MD0151	ELKTON	0- 2	54- 58	190-210	42- 48	2- 8

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
MD0052	NONE		0-1.0	APPARENT	NOV-MAY	>60	
MD0151	NONE		-	APPARENT	-	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
MD0052	0-10	SIL L	0- 0	100-100	11-25	5- 10
MD0052	0-10	SL	0- 0	95-100	11-20	5- 10
MD0052	0-10	SICL	0- 0	100-100	27-35	5- 10
MD0052	10-24	SICL	0- 0	100-100	27-35	5- 15
MD0052	24-40	SICL SIC	0- 0	100-100	27-45	5- 15
MD0052	40-65	VFSL FSL	0- 0	95-100	10-20	2- 10
MD0151	0- 6	MK-SIL SIL	0- 0	100-100	14-25	5- 20
MD0151	6-15	SIL	0- 0	100-100	20-27	2- 5
MD0151	15-40	SICL SIC	0- 0	100-100	27-45	5- 15

MD0151	40-65	CL VFSL L			0- 0	100-100	18-35	5- 15
MD0151	65-72	FS LFS			0- 0	85-100	3-10	2- 5

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
MD0052	0-10	3.5- 5.5	1.-4.	0- 0	0.6- 2.0	LOW
MD0052	0-10	3.5- 5.5	1.-4.	0- 0	0.6- 2.0	LOW
MD0052	0-10	3.5- 6.5	1.-4.	0- 0	0.2- 0.6	LOW
MD0052	10-24	3.5- 5.5	0.-.5	0- 0	0.06- 0.2	MODERATE
MD0052	24-40	3.5- 5.5	0.-.5	0- 0	0.00- 0.2	MODERATE
MD0052	40-65	3.5- 5.5	0.-.5	0- 0	0.2- 20	LOW
MD0151	0- 6	3.5- 5.5	3.-10	0- 0	0.6- 2.0	LOW
MD0151	6-15	3.5- 5.5	.5-1.	0- 0	0.6- 2.0	LOW
MD0151	15-40	3.5- 5.5	0.-.5	0- 0	0.06- 0.2	MODERATE
MD0151	40-65	3.5- 5.5	0.-.5	0- 0	0.2- 0.6	LOW
MD0151	65-72	3.5- 5.5	0.-.5	0- 0	2.0- 20	LOW

LOCATION KEYPORT NJ+DE MD VA
Established Series
Rev. CFE-JEW-MJL
11/2002

KEYPORT SERIES

The Keyport series consists of very deep, moderately well drained soils on uplands. They formed in Coastal Plain sediments. Permeability is slow or very slow. Slopes range from 0 to 25 percent. Mean annual temperature is 56 degrees F., and mean annual precipitation is 45 inches.

TAXONOMIC CLASS: Fine, mixed, semiactive, mesic Aquic Hapludults

TYPICAL PEDON: Keyport silt loam - cultivated. (Colors are for moist soil.)

Ap--0 to 10 inches; dark brown (10YR 4/3) silt loam; weak medium and fine granular structure; friable; many fine roots; medium acid; clear smooth boundary. (0 to 12 inches thick)

Bt1--10 to 16 inches; yellowish brown (10YR 5/4) silty clay loam; very weak medium prismatic structure parting to strong medium angular blocky; slightly firm, slightly sticky; many faint clay films on peds; very few coarse roots; strongly acid; gradual smooth boundary. (6 to 10 inches thick)

Bt2--16 to 26 inches; yellowish brown (10YR 5/4) silty clay loam; common medium distinct yellowish brown (10YR 5/8) mottles; moderate medium prismatic structure parting to strong medium angular and subangular blocky; firm; many prominent clay films on peds; strongly acid; clear smooth boundary. (8 to 10 inches thick)

Bt3--26 to 44 inches; dark yellowish brown (10YR 4/4) silty clay loam, common medium distinct gray (10YR 5/1) mottles; moderate medium angular and subangular blocky structure; sticky; many faint clay films on peds; very strongly acid; gradual smooth boundary. (6 to 20 inches thick)

Cg--44 to 65 inches; dark gray (N 4/) silty clay loam; dark yellowish brown (10YR 4/4) mottles; massive; slightly sticky; extremely acid.

TYPE LOCATION: Mercer County, New Jersey; 3/4 mile east of Edgebrook and Route 130, Gruber Farm.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. Coarse fragments are lacking, or essentially so, in the solum. Depth to unconforming coarser materials is typically more than 5 feet. Reaction is strongly to extremely acid throughout except where limed.

The Ap horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chromas of 2 to 4. In unplowed areas the A1 horizon is about 4 inches thick and has value of 3 or 4. Textures are silt loam, loam, or fine sandy loam. Some areas are eroded.

The Bt horizon has hues of 5YR to 2.5Y, values of 4 to 7, and chromas of 0 to 8 with 1 and 2 chromas only in the Bt3 horizon of some pedons. Mottles with 2 or lower chroma are in the Bt horizon between 20 and 30 inches from the soil surface. Textures range from silty clay loam or clay loam to silty clay and clay. Mean clay content is about 40 percent in the control section. Structure commonly is blocky but prismatic or columnar structure occurs in many pedons and subangular blocky and platy structures are in a few pedons. Some pedons have thin layers of silt loam.

The C or Cg horizon has hues of 10YR to 5Y, values of 2 to 7, and chroma of 0 to 8. High values and chroma are in moderately coarse and coarse textural strata. Texture typically is silty clay loam but ranges from clay to loamy sand. Thin iron sheets 1/16 to 1/8 inches thick form in both vertical and horizontal fracture faces in the C horizon of some pedons and iron-pyrite nodules also occur in some pedons.

COMPETING SERIES: The Coolville, Cruze, Donlonton, Kreamer, Latham, Piney, Rarden, Wharton and Zoar soils are members of the same family. The Coolville and Zoar soils have argillic horizons with the lower boundary within a 40 inch depth. Kreamer soils have coarse fragments dominated by chert. Wharton soils have shale and sandstone coarse fragments in the solum. The Donlonton soils have glauconite in the solum. The Cruze, Latham, Piney and Rarden soils have sola less than 40 inches thick.

Other competing soils in closely related families are the Adelphia, Dogue, Holmdel, Mattapex, Tygart and Woodstown series. All of these series except Dogue and Tygart soils have less than 35 percent clay in the control section. In addition, the Adelphia and Holmdel soils contain glauconite. Dogue soils have soil temperatures higher than 59 degrees F. Tygart soils have dominant chromas of 1 or 2 in the argillic horizon.

GEOGRAPHIC SETTING: Keyport soils developed in old moderately fine textured acid sediments on broad lowlands and slight depressions in the northern portions of the Atlantic Coastal Plain. Slopes are mostly gentle or nearly level but range to moderately steep. The climate is temperate and humid with mean annual air temperatures of 50 to 58 degrees F. and mean annual precipitation of 40 to 48 inches. Frost free days are 180 to 215.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Elkton, Othello and Matawan soils. The Elkton and Othello soils are dominantly gray in color and have poorer drainage. Matawan soils have less than 35 percent clay in the control section and siliceous mineralogy.

DRAINAGE AND PERMEABILITY: Keyport soils are moderately well drained. Permeability is slow or very slow. Runoff is slow except on the strong slopes.

USE AND VEGETATION: Most areas have been cleared for farming or general crops, hay and pasture. Natural vegetation consists mostly or red, white and black oaks, beech, hickory and Virginia pine. In places there are excellent stands of yellow poplar. Sweetgum seeds in on level areas if seed trees are nearby.

DISTRIBUTION AND EXTENT: Keyport soils are of moderate extent, more than 70,000 acres, in New Jersey, Delaware, and Maryland.

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Published in Soil Survey of Freehold Area, N.J. which included northern Monmouth County, New Jersey, 1913.

Remarks: Diagnostic horizons and features recognized in this feature are:
a. argillic - zone of 16 to 26 inches (Bt1,Bt2) averages 20 percent more clay than surface.
b. Ultisol - base saturation in zone of 44-65 inches (C) is presumed to be less than 35 percent.
c. Aquic - in the zone of 26-44 inches are mottles with chrome of 1. d. clayey - in the zone of 10 to 30 inches (Bt1,Bt2,Bt3) clay percentage is presumed to average more than 35 percent.

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
NJ0052	KEYPORT	0- 25	50- 58	180-215	40- 48	5- 120

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
NJ0052	NONE		1.5-4.0	PERCHED	NOV-MAY	60-60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
NJ0052	0-10	SIL L	0- 0	95-100	10-25	6- 14
NJ0052	0-10	SL FSL	0- 0	95-100	5-20	4- 12
NJ0052	0-10	LS S	0- 0	100-100	1- 7	1- 4
NJ0052	10-60	SICL CL C	0- 0	95-100	30-50	12- 20
NJ0052	60-72	SR C LS	0- 0	95-100	5-50	2- 16

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
NJ0052	0-10	3.6- 5.5	1.-3.	0- 0	0.2- 2.0	LOW
NJ0052	0-10	3.6- 5.5	1.-3.	0- 0	0.6- 6.0	LOW
NJ0052	0-10	3.6- 5.5	.5-1.	0- 0	6.0- 20	LOW
NJ0052	10-60	4.5- 5.5	0.-.5	0- 0	0.0- 0.2	MODERATE
NJ0052	60-72	3.6- 5.5	0.-.5	0- 0	0.06- 20	LOW

LOCATION LENNI DE+MD NJ
Established Series
CDP/Rev. PSK-JAK-JWB
10/2005

LENNI SERIES

MLRA(s): 149A, 153C, 153D
Depth Class: Very deep
Drainage Class (Agricultural): Poorly drained
Saturated Hydraulic Conductivity Class: Moderately low
Permeability (obsolete): Slow
Landscape: Coastal plain
Parent Material: Clayey eolian deposits underlain by sandy (fluviomarine) deposits
Slope: 0 to 5 percent
Mean Annual Air Temperature (type location): 56 degrees F.
Mean Annual Precipitation (type location): 45 inches

TAXONOMIC CLASS: Fine, mixed, active, mesic Typic Endoaquults

TYPICAL PEDON: Lenni silt loam (in an area of Lenni silt loam, 0 to 2 percent slopes) on a smooth 1 percent slope in woodland. (Colors are for moist soil unless otherwise indicated.)

Oe--0 to 2 inches; moderately decomposed plant material, loose leaves, and twigs. (0 to 3 inches thick)

A--2 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, brown (10YR 4/3) dry; moderate coarse granular structure; very friable, nonsticky; nonplastic; many fine and medium and few coarse roots throughout; extremely acid; abrupt wavy boundary. (2 to 9 inches thick)

Eg--7 to 11 inches; light gray (5Y 7/2) loam; moderate fine and medium subangular blocky structure; friable; slightly sticky; nonplastic; common fine and medium roots and few coarse roots; few fine distinct brownish yellow (10YR 6/6) iron masses; extremely acid; abrupt smooth boundary. (0 to 8 inches thick)

Btg1--11 to 14 inches; light brownish gray (2.5Y 6/2) loam; moderate fine and medium subangular blocky structure; friable; slightly sticky; nonplastic; common fine and very fine roots; dark stains in root channels; few fine prominent strong brown (7.5YR 5/8) iron masses; extremely acid; clear smooth boundary.

Btg2--14 to 24 inches; grayish brown (2.5Y 5/2) clay; strong medium and coarse subangular blocky structure; firm; slightly sticky; slightly plastic; common medium prominent reddish yellow (5YR 6/6) and common medium distinct brownish yellow (10YR 6/6) iron masses; common very fine and fine roots; common faint clay films on faces of peds and in pores; extremely acid; clear smooth boundary.

Btg3--24 to 47 inches; gray (5Y 6/1) clay; weak coarse prismatic structure parting to strong fine and medium angular blocky; firm; moderately sticky; slightly plastic; few fine and very fine roots between peds; common medium prominent yellowish brown (10YR 5/8) and few medium prominent red (2.5YR 5/8) iron masses throughout; few distinct dark gray (5Y 4/1) skeletans on faces of peds and in pores; extremely acid; clear smooth boundary. (Combined thickness of Btg horizon is 22 to 48 inches.)

2BCg--47 to 51 inches; light gray (5Y 7/2) clay loam; weak fine and medium subangular blocky structure; friable; slightly sticky; nonplastic; few fine roots between peds; many medium prominent strong brown (7.5YR 5/8) iron masses; very strongly acid; abrupt smooth boundary. (0 to 10 inches thick)

2Cg1--51 to 56 inches; light gray (5Y 7/1) sandy loam; massive; friable; nonsticky; nonplastic; few fine roots; many coarse prominent strong brown (7.5YR 5/8) and reddish yellow (7.5YR 6/8) iron masses; 2 percent, by volume pebbles; extremely acid; gradual wavy boundary.

2Cg2--56 to 76 inches; gray (5Y 5/1) and grayish brown (2.5Y 5/2) sandy loam; massive; very friable; nonsticky; nonplastic; few coarse roots; common coarse prominent strong brown (7.5YR 5/8) and distinct brownish yellow (10YR 6/6) iron masses; common fine feldspar grains; 1 percent, by volume pebbles; very strongly acid.

TYPE LOCATION: Sussex County, Delaware; Southwest of Seaford, approximately 200 feet east and 850 feet north of the intersection of County Roads 541 and 538, about 60 feet into the woods east of the ditch along edge of field; USGS Sharptown, Delaware quadrangle; lat. 38 degrees 37 minutes 25 seconds N. and long. 75 degrees 39 minutes 49 seconds W., NAD 83.

RANGE IN CHARACTERISTICS:
Depth to base of Argillic horizon: 30 to 70 inches
Depth to Bedrock: Greater than 72 inches
Depth to Seasonal High Water Table: 0 to 6 inches, December to May
Rock fragments: 0 to 5 percent, by volume throughout the profile; mostly pebbles
Soil Reaction: Extremely acid to strongly acid throughout the profile, unless limed

RANGE OF INDIVIDUAL HORIZONS:
Oe horizon:
Texture: Moderately decomposed plant materials, including some leaves and twigs

A or Ap horizon:Color--hue of 10YR to 5Y, value of 3 to 7, chroma of 1 to 3, or is neutral with value of 3 to 7
Texture--silt loam, loam, or fine sandy loam
Redoximorphic features (if they occur)--iron masses in shade of red, yellow, or brown and iron depletions in shades of brown, yellow, olive, or gray

Eg horizon:
Color--hue of 10YR to 5Y, value of 3 to 7, chroma of 1 to 3, or is neutral with value of 3 to 7
Texture--loam, fine sandy loam, or silt loam
Redoximorphic features--iron masses in shade of red, yellow, or brown and iron depletions in shades of brown, yellow, olive, or gray

Btg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, chroma 1 or 2, or is neutral with value of 4 to 7
Texture--loam, silty clay loam, silty clay, or clay
Redoximorphic features--iron masses in shade of red, yellow, or brown and iron depletions in shades of brown, yellow, olive, or gray

2BCg horizon:
Color--hue of 10YR to 5Y, value of 4 to 7, chroma of 1 or 2, or is neutral with value of 3 to 7
Texture--fine sandy loam, loam, sandy clay loam, or clay loam
Redoximorphic features--iron masses in shade of red, yellow, or brown and iron depletions in shades of brown, yellow, olive, or gray

2Cg horizon:
Color--hue of 10YR to 5Y, values of 4 to 7, chroma of 1 or 2, or is neutral with value of 3 to 7
Texture--loamy fine sand, loamy sand, coarse loamy sand, sandy loam, loam, or sandy clay loam. Some pedons may be stratified.
Redoximorphic features--iron masses in shade of red, yellow, or brown and iron depletions in shades of brown, yellow, olive, or gray

COMPETING SERIES:
Armagh soils--formed in residuum from acid gray shale
Kinkora soils--formed in old, clayey alluvial sediments derived from mixed crystalline rock; on terraces in the northern Piedmont Plateau
Purdy soils--formed in old, clayey alluvial sediments derived from mixed sedimentary rocks; on terraces primarily in the Ridge and Valley province

GEOGRAPHIC SETTING:
Landscape: Coastal plain
Landform: (Low-lying uplands), broad interstream divides, and shallow depressions
Geomorphic Component: Dips and talfs
Parent Material: Clayey eolian deposits underlain by sandy (fluviomarine) deposits
Slope: 0 to 5 percent
Elevation: 10 to 100 feet
Frost Free Period: 185 to 205 days
Mean Annual Air Temperature: 52 to 58 degrees F.
Mean Annual Precipitation: 42 to 48 inches

GEOGRAPHICALLY ASSOCIATED SOILS:
Elkton soils--have 27 to 35 percent clay in the particle-size control section; on similar landforms
Fallsington soils--have 18 to 35 percent clay in the particle-size control section; on similar landforms
Keyport soils--have a seasonal high water table at 18 to 48 inches below the soil surface (moderately well drained); on higher landforms
Matapeake soils--have a seasonal high water table at 48 to more than 72 inches below the soil surface (well drained); on higher landforms
Mattapex soils--have a seasonal high water table at 18 to 36 inches below the soil surface (moderately well drained); on higher landforms
Othello soils--have 18 to 27 percent clay in the particle-size control section; on similar landforms
Pepperbox soils--have a seasonal high water table at 24 to 36 inches below the soil surface

(moderately well drained); on slightly higher landforms capped by eolian sands
Rosedale soils--have a seasonal high water table at 48 to 72 inches below the soil surface (well drained); on higher landforms capped by eolian sands

DRAINAGE AND SATURATED HYDRAULIC CONDUCTIVITY:
Drainage Class (Agricultural): Poorly drained
Internal Free Water Occurrence: Very Shallow (0 to 10 inches) and common (present 3 to 6 months)
Flooding Frequency and Duration: None
Ponding Frequency and Duration: Rare to occasional, and brief
Index Surface Runoff: Low or medium
Saturated Hydraulic Conductivity: Moderately low
Permeability (obsolete): Slow
Shrink-swell potential: Moderate

USE AND VEGETATION:
Major Uses: Cultivated crops
Dominant Vegetation: Where cultivated--mostly agronomic crops such as corn, wheat and soybeans. Where wooded--Basket Oak (Quercus prinus), Sweet Gum (Liquidambar stryaciflua), Loblolly Pine (Pinus taeda) and American Holly (Ilex opaca).

DISTRIBUTION AND EXTENT:
Distribution: Coastal Plain of Delaware, Maryland, and New Jersey
Extent: Moderate

MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia

SERIES ESTABLISHED: Gloucester County, New Jersey, 2004.

REMARKS: This soil was formerly included in the Elkton series (before it was recorrelated to fine-silty).
Diagnostic horizons and soil characteristics recognized in this pedon:
Ochric epipedon--the zone from 2 to 11 inches (Ap and Eg horizon)
Argillic horizon--the zone from 11 to 47 inches (Btg horizon)
Aquic conditions--the soil has redox depletions and concentrations within the upper 24 inches of the argillic horizon, with periodic saturation and reduction at some time during the year
Other soil features identified with this pedon:
Series control section--the zone from 0 to 60 inches

ADDITIONAL DATA: This pedon sampled as S93DE-005-014.
Data Mapunit ID (type location): 444562

LOCATION MATAPEAKE MD+DE NJ VA
Established Series
WDC-JEB/Rev. JAK
11/2002

MATAPEAKE SERIES

MLRA(S): 149A, 153A, 153B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Well drained
PERMEABILITY: Moderate to moderately slow
SURFACE RUNOFF: Medium
PARENT MATERIAL: Silty eolian sediments underlain by coarser fluvial or marine sediments
SLOPE: 0 to 30 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 56 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 40 inches

TAXONOMIC CLASS: Fine-silty, mixed, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Matapeake silt loam, in an orchard with shallow cultivation. (Colors are for moist soil.)

Ap--0 to 5 inches; grayish brown (2.5Y 5/2) silt loam; weak fine and medium granular structure; friable; many roots; slightly acid; abrupt smooth boundary. (0 to 10 inches thick)

E--5 to 11 inches; light yellowish brown (2.5Y 6/4) silt loam; weak fine and medium granular and weak fine subangular blocky structure; friable; common roots; strongly acid; clear wavy boundary. (0 to 11 inches thick)

Bt1--11 to 16 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; strongly acid; clear wavy boundary.

Bt2--16 to 34 inches; strong brown (7.5YR 5/6) silt loam; moderate medium and coarse subangular blocky structure; firm; sticky, plastic; few roots; many medium clay films on ped faces; very strongly acid; gradual smooth boundary. (Combined thickness of the Bt horizon is 15 to 30 inches.)

2BC--34 to 38 inches; strong brown (7.5YR 5/6) sandy loam; weak medium and coarse subangular blocky structure; friable; slightly sticky, slightly plastic; few faint clay films; very strongly acid; clear smooth boundary. (0 to 8 inches thick)

2C1--38 to 58 inches; light yellowish brown (2.5YR 6/4) sandy loam; a few streaks of light gray (5Y 5/2) clean sand; massive; very friable: slightly sticky; very strongly acid; clear smooth boundary.

2C2--58 to 62 inches; pale yellow (5Y 7/3) and yellowish brown (10YR 5/8) loamy sand; single grain, loose; very strongly acid.

TYPE LOCATION: Wicomico County, Maryland; 1.7 miles southwest of Allen.

RANGE IN CHARACTERISTICS:
Solum Thickness: 24 to 60 inches
Depth to Bedrock: Greater than 72 inches
Depth to Seasonal High Water Table: Greater than 72 inches. At elevations below 25 feet, some pedons have an apparent water table from 48 to 72 inches.
Depth to Lithologic Discontinuity: 30 to 40 inches
Rock Fragments: Less than 5 percent, by volume in the A and Bt horizons and 0 to 10 percent in the 2BC and 2C horizons, mostly quartz pebbles
Soil Reaction: Extremely acid to strongly acid, throughout the profile, unless limed
Other Features: The transition from the fine-silty Bt horizon to the sandy 2C horizon is greater than 5 inches thick.

RANGE OF INDIVIDUAL HORIZONS:
Ap horizon:
Color--hue of 10YR or 2.5Y, value of 4 to 6, chroma of 2 to 6.
Texture--silt loam, loam, or fine sandy loam

A horizon (if it occurs is less than 7 inches thick if the value is 3 or less):
Color--hue of 10YR or 2.5Y, value of 3 or 4, chroma of 1 to 3
Texture--silt loam, loam, or fine sandy loam

E horizon:
Color--hue of 10YR on 2.5Y, value of 5 or 6, chroma of 4 to 6
Texture--silt loam, loam, or fine sandy loam

The Bt horizon:
Color--hue of 7.5YR or 10YR, value of 4 or 5, chroma of 4 to 8
Texture--silt loam or silty clay loam

2BC horizon:
Color--hue of 7.5YR or 10YR, value of 4 to 6, chroma of 4 to 8
Texture-loam, fine sandy loam, or sandy loam

2C horizon:
Color--hue of 5YR to 5Y, value of 4 to 7, chroma of 3 to 8. Some pedons have streaks of clean sand with chroma of 3 or less.
Texture--fine sandy loam, sandy loam, loamy fine sand, loamy sand, or sand. Some pedons have thin gravelly strata less than 1 foot thick.

COMPETING SERIES:
Cabool soils--moderately deep to lithic contact and formed in loess underlain by residuum from of chert and sandstone
Chillum soils--have a dense compact 2C horizon that is firm or very firm
Fletcher soils--deep to lithic contact and formed in residuum from phyllite

Gnawbone soils--moderately deep to paralithic contact and formed in residuum from siltstone
Greenbriar soils--deep to lithic contact and formed in a silty mantle underlain by residuum from acid shale and siltstone
Jessietown soils--moderately deep to lithic contact and formed in a silty mantle underlain by residuum from acid shale and siltstone
Nassawango soils--have a perched water table at a depth of 42 to 72 inches
Purcellville soils--formed in residuum weathered from diorite, biotite schist, and greenstone schist
Talleyville soils--have sola more than 48 inches thick and formed in a silty mantle underlain by residuum weathered from basic rocks
Wernock soils--moderately deep to paralithic contact and formed in residuum weathered from shale, siltstone, and sandstone
Whitley soils--formed in silty alluvium derived from sandstone, siltstone, and shale
Wrays soils--deep to lithic contact and formed in loess underlain by residuum from siltstone

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Upland interfluves and side slopes
Elevation: 5 to 125 feet
Parent Material: Silty eolian sediments underlain by coarser fluvial or marine sediments
Mean Annual Air Temperature: 52 to 57 degrees F.
Mean Annual Precipitation: 42 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Chillum soils--have a dense compact 2C horizon that is firm or very firm, on similar landforms
Mattapex soils--moderately well drained soils with a seasonal high water table at 18 to 36 inches, on slightly lower-lying landforms
Sassafras soils--have a fine-loamy particle-size control section, on similar landforms
Butlertown soils--moderately well drained soils that have a fragipan on slightly lower-lying landforms
Othello soils--poorly drained soils, on lower-lying landforms
Fallsington soils--poorly drained soils that have a fine-loamy particle-size control section, on lower-lying landforms
Fallsington soils
Woodstown soils--moderately well drained soils that have a fine-loamy particle-size control section, on slightly lower-lying landforms

USE: Almost all areas of Matapeake soils are cultivated. Corn, soybeans, and small grains are commonly grown. A small amount of acreage is irrigated.

VEGETATION: Native vegetation is dominated by oaks and some cutover areas have loblolly, Virginia, or shortleaf pine.

DISTRIBUTION: The Coastal Plain of Maryland, Delaware, and New Jersey

EXTENT: Large

SERIES ESTABLISHED: Pasquotank County, North Carolina, 1951

REMARKS: Matapeake soils were previously classified as having a fine-loamy particle-size control section.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the surface to a depth of 11 inches (Ap and E horizons)
Argillic horizon--the zone from 11 to 38 inches (Bt1, Bt2, and 2BC horizons)

SERIES INTERPRETATION RECORD(S): MD0037, MD0130 (WET SUBSTRATUM)

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
MD0037	MATAPEAKE	0- 30	52- 57	190-210	42- 48	5- 120
MD0130	MATAPEAKE	0- 5	52- 57	190-210	42- 48	5- 30

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
MD0037	NONE		6.0-6.0		-	>60	
MD0130	NONE		4.0-6.0	APPARENT	JAN-APR	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
MD0037	0-11	SIL	0- 0	100-100	5-15	-
MD0037	0-11	FSL	0- 0	100-100	5-15	-
MD0037	0-11	L	0- 0	100-100	5-15	-
MD0037	11-34	SIL SICL L	0- 0	100-100	18-30	-
MD0037	34-62	SL LS S	0- 0	90-100	2-20	-
MD0130	0- 7	SIL FSL	0- 0	100-100	10-18	5- 15
MD0130	7-13	SIL	0- 0	100-100	10-18	5- 15
MD0130	13-38	SIL SICL	0- 0	100-100	18-30	2- 10
MD0130	38-46	SL L FSL	0- 0	75-100	10-22	2- 10
MD0130	46-72	LS S LFS	0- 0	75-100	3-10	2- 10

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
MD0037	0-11	4.5- 5.5	1.-2.	0- 0	0.6- 2.0	LOW

MD0037	0-11	4.5- 5.5	1.-2.	0- 0	0.6- 2.0	LOW
MD0037	0-11	4.5- 5.5	1.-2.	0- 0	0.6- 2.0	LOW
MD0037	11-34	3.6- 5.5	0.-.5	0- 0	0.2- 2.0	LOW
MD0037	34-62	3.6- 5.5	0.-.5	0- 0	0.6- 6.0	LOW
MD0130	0- 7	4.5- 7.3	1.-2.	0- 0	0.6- 2.0	LOW
MD0130	7-13	3.6- 6.0	0.-.5	0- 0	0.6- 2.0	LOW
MD0130	13-38	3.6- 5.5	0.-.5	0- 0	0.2- 2.0	LOW
MD0130	38-46	3.6- 5.5	0.-.5	0- 0	0.6- 6.0	LOW
MD0130	46-72	3.6- 5.5	0.-.5	0- 0	6.0- 20	LOW

LOCATION MATTAPEX MD+DE NJ VA
Established Series
JEB/Rev. JAK
11/2002

MATTAPEX SERIES

MLRA(S): 149A, 153A, 153B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Moderately well drained
PERMEABILITY: Moderate or moderately slow
SURFACE RUNOFF: Slow or medium
PARENT MATERIAL: Silty eolian sediments, underlain by coarser fluvial or marine sediments
SLOPE: 0 to 30 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 55 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 43 inches

TAXONOMIC CLASS: Fine-silty, mixed, active, mesic Aquic Hapludults

TYPICAL PEDON: Mattapex loam, cultivated. (Colors are for moist soil.)

Ap--0 to 11 inches; dark grayish brown (10YR 4/2) loam; weak medium granular structure; friable; slightly sticky, slightly plastic; many fine and medium roots; moderately acid; gradual smooth boundary. (0 to 12 inches thick)

BE--11 to 15 inches; yellowish brown (10YR 5/6) loam; weak and moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common fine and medium fine roots; strongly acid; gradual smooth boundary. (0 to 8 inches thick)

Bt1--15 to 26 inches; yellowish brown (1OYR 5/6) silty clay loam; moderate medium subangular blocky structure; friable; moderately sticky, slightly plastic; few medium roots common faint yellowish brown (1OYR 5/4) clay films on faces of peds; strongly acid; gradual smooth boundary.

Bt2--26 to 36 inches; light olive brown (2.5Y 5/4) silty clay loam; weak medium subangular blocky structure; firm; moderately sticky, slightly plastic; few distinct yellowish brown (10YR 5/6) clay films on faces of peds; common medium distinct strong brown (7.5YR 5/6) iron accumulations and brownish gray (2.5Y 6/2) iron depletions; very strongly acid; clear wavy boundary. (Combined thickness of Bt is 15 to 40 inches.)

2C1--36 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam; massive; friable; nonsticky, slightly plastic; common medium distinct light gray (2.5Y 7/2) iron depletions and strong brown (7.5YR 5/6) iron accumulations; very strongly acid; clear smooth boundary.

2C2--60 to 65 inches; yellowish brown (10YR 5/4) loamy sand; massive; friable; nonsticky, slightly plastic; common medium distinct light gray (2.5Y 7/2) iron depletions and strong brown (7.5YR 5/6) iron accumulations; very strongly acid.

TYPE LOCATION: Queen Anne's County, Maryland; Mattapex Plantation on Kent Island, 0.25 mile west of Route 33.

RANGE IN CHARACTERISTICS:
Solum Thickness: 24 to 48 inches
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: 18 to 36 inches, January to April
Depth to the Lithologic Discontinuity: 30 to 50 inches
Rock Fragments: 0 to 5 percent, by volume throughout the profile. Individual horizons, generally less than 12 inches thick, range to 20 percent
Soil Reaction: Extremely acid to strongly acid, throughout the profile, unless limed

RANGE OF INDIVIDUAL HORIZONS:
A or Ap horizon:
Color--hue of 10YR or 2.5Y, value of 3 to 5, chroma of 1 to 4
Texture--silt loam, loam, or fine sandy loam

E or BE horizon:
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 3 or 4
Texture--silt loam, loam, or fine sandy loam
Redoximorphic Features--iron accumulations in shades of red, brown, yellow, or olive

Bt horizon:
Color--hue of 7.5YR to 2.5Y, value of 5 to 6, chroma of 3 to 8
Texture--silt loam or silty clay loam, with 18 to 30 percent clay and more than 50 percent silt in the particle size control section
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

Btg horizon (if it occurs):
Color--hue of 10YR or 5Y, value of 5 to 7, chroma of 1 or 2
Texture--silt loam or silty clay loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

2BC horizon (if it occurs):
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 3 to 6
Texture--loam, fine sandy loam, sandy clay loam, or loamy sand
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

2BCg horizon (if it occurs):
Color--hue of 10YR or 5Y, value of 5 to 7, chroma of 1 or 2
Texture--loam, fine sandy loam, sandy clay loam, or loamy sand

Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

2C horizon:
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 3 to 6
Texture--loam, fine sandy loam, sandy loam, loamy sand, loamy fine sand, or sand
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

2Cg horizon (if it occurs)
Color--hue of 10YR or 5Y, value of 5 to 7, chroma of 1 or 2
Texture--loam, fine sandy loam, sandy loam, loamy sand, loamy fine sand, or sand
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

COMPETING SERIES:
Berea soils--moderately deep to paralithic contact and formed in residuum from acid shale
Deputy soils--deep to paratithic contact and formed in loess underlain by residuum weathered from shale
Hibler soil--old alluvial soils influenced by limestone bedrock, on river terraces
Knobtop soils--moderately deep to lithic contact and formed in loess underlain by residuum weathered from igneous rocks
Marquand soils--formed in silty and loamy sediments derived form loess, colluvium and alluvium and typically have greater than 60 inch solum thickness
Morehead soils--formed in old alluvium, high in silt, derived from shale, siltstone, and sandstone
Scottsburg soils--formed in loess and residuum from acid shale and have fragic soil properties
Sharptown soils--contain more than 10 percent, by volume glauconite in the subsoil

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Marine terraces and uplands
Elevation: 5 to 120 feet
Parent Material: Silty eolian sediments, underlain by coarser fluvial or marine sediments
Mean Annual Air Temperature: 52 to 57 degrees F.
Mean Annual Precipitation: 42 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Butlertown soils--are slowly permeable and have a fragipan, on similar landforms
Matapeake soils--are well drained with a seasonal high water table at depths greater than 72 inches, on slightly higher positions
Othello soils--poorly drained soils with a seasonal high water table at 0 to 12, on lower-lying positions
Pineyneck soils--have a coarse-loamy particle-size control section, on similar landforms
Sassafras soils--are well drained and have a fine-loamy particle-size control section, on slightly higher landforms
Unicorn soils--are well drained and have a coarse-loamy particle-size control section, on slightly higher landforms

Whitemarsh soils--have an abrupt texture change at the top of the argillic horizon and are poorly drained with a seasonal high water table at 0 to 12, on lower-lying positions

USE: Most areas are cultivated and used for corn, soybeans, and small grains. Some areas are in urban uses and some are used for vegetables, hay, or pasture.

VEGETATION: Wooded area are dominantly mixed hardwoods, dominated by oaks, sweetgum, red maple, and holly. Loblolly pine occurs in some second growth areas.

DISTRIBUTION: Coastal Plain of Maryland, Delaware, and New Jersey

EXTENT: Large

SERIES ESTABLISHED: Pasquotank County, North Carolina, 1951

REMARKS: Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the surface to 15 inches (Ap and BE horizons)
Argillic horizon--the zone from 15 to 36 inches (Bt1 and Bt2 horizons)
Aquic conditions--the zone from 26 inches to a depth of 80 inches is periodically saturated (endosaturation)

SERIES INTERPRETATION RECORD(S): MD0035

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
MD0035	MATTAPEX	0- 30	52- 57	190-210	42- 48	5- 120

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
MD0035	NONE		1.5-3.0	APPARENT	JAN-APR	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
MD0035	0-15	L	0- 0	100-100	10-18	2- 15
MD0035	0-15	SIL	0- 0	90-100	10-18	2- 15
MD0035	0-15	FSL	0- 0	90-100	10-18	2- 15
MD0035	15-36	SICL SIL	0- 0	100-100	18-30	2- 10
MD0035	36-60	FSL L LS	0- 0	90-100	8-15	2- 5
MD0035	60-65	S LS	0- 0	90-100	3- 8	2- 5

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
MD0035	0-15	3.6- 5.5	.5-3.	0- 0	0.6- 2.0	LOW
MD0035	0-15	3.6- 5.5	.5-3.	0- 0	0.6- 2.0	LOW
MD0035	0-15	3.6- 5.5	.5-3.	0- 0	0.6- 2.0	LOW
MD0035	15-36	3.6- 5.5	0.-.5	0- 0	0.2- 2.0	LOW
MD0035	36-60	3.6- 5.5	0.-.5	0- 0	0.6- 6.0	LOW
MD0035	60-65	3.6- 5.5	0.-.5	0- 0	6.0- 20	LOW

LOCATION NASSAWANGO MD
Established Series
GPD-JEB-WDC/Rev. JAK
11/2002

NASSAWANGO SERIES

MLRA(S): 153B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Well drained
PERMEABILITY: Moderately slow
SURFACE RUNOFF: Slow or medium
PARENT MATERIAL: Silty eolian deposits underlain by loamy and sandy alluvial and marine sediments
SLOPE: 0 to 5 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 57 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 44 inches

TAXONOMIC CLASS: Fine-silty, mixed, semiactive, mesic Typic Hapludults

TYPICAL PEDON: Nassawango silt loam, on a smooth 0 percent slope, in a cultivated field. (Colors are for moist soil.)

Ap--0 to 10 inches; dark brown (10YR 4/3) silt loam; weak fine granular structure; friable; slightly sticky, nonplastic; many fine and medium roots; very strongly acid; abrupt smooth boundary. (7 to 12 inches thick)

E--10 to 16 inches; light yellowish brown (10YR 6/4) silt loam; weak medium subangular blocky structure; friable; slightly sticky, nonplastic; many very fine and fine roots; strongly acid; clear smooth boundary. (0 to 8 inches thick)

Bt--16 to 36 inches; yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; moderately sticky, slightly plastic; common very fine and fine roots; distinct strong brown (7.5YR 5/8) clay films on faces of peds; very strongly acid; clear smooth boundary. (14 to 24 inches thick)

BC--36 to 44 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; few fine roots; extremely acid; clear smooth boundary. (0 to 10 inches thick)

2C1--44 to 48 inches; light yellowish brown (10YR 6/4) loamy sand; massive; very friable; nonsticky, nonplastic; few very fine roots; few, fine distinct yellowish brown (10YR 5/6) iron accumulations; extremely acid; clear wavy boundary.

2C2--48 to 60 inches; light yellowish brown (10YR 6/4) sand; massive; very friable; nonsticky, nonplastic; few very fine roots; few medium prominent light gray (10YR 7/1) iron depletions; extremely acid; clear smooth boundary.

2Cg--60 to 72 inches; light gray (5Y 7/1) fine sandy loam; massive; firm; nonsticky, nonplastic; few, coarse, prominent strong brown (7.5YR 5/8) iron accumulations; extremely acid.

TYPE LOCATION: Worcester County, Maryland; 0.1 mi South of Massey Branch on Old US Rt. 113, 100 feet East in a cultivated field: lat. 38 degrees 16 minutes 00 seconds N. and long. 75 degrees 16 minutes 30 seconds W.

RANGE IN CHARACTERISTICS:
Solum Thickness: 35 to 60 inches
Depth to Bedrock: Greater than 60 inches
Depth to Lithologic Discontinuity: 20 to 40 inches
Depth to Seasonal High Water Table: 42 to 72 inches, December to April
Rock Fragments: 0 to 5 percent, by volume in the solum and 0 to 10 percent in the substratum, mostly rounded gravel
Soil Reaction: Extremely acid to strongly acid, throughout the profile, unless limed

RANGE OF INDIVIDUAL HORIZONS:

A or Ap horizon:
Color-hue of 10YR or 2.5Y, value of 3 to 6, chroma of 3 to 6
Texture--silt loam, loam, or fine sandy loam

E or BE horizon:
Color--hue of 10YR or 2.5Y, value of 3 to 6, chroma of 4 to 6
Texture--is silt loam or fine sandy loam

Bt horizon:
Color--hue of 7.5YR to 2.5Y, value of 4 to 6, chroma of 4 to 6
Texture--silt loam or silty clay loam

BC horizon:
Color--hue of 7.5YR to 2.5Y, value of 5 or 6, chroma of 4 to 8
Texture--silt loam or silty clay loam

2BC horizon (if it occurs):
Color--hue of 7.5YR to 2.5Y, value of 4 to 7, chroma of 3 to 6
Texture--loamy sand, sandy loam, loam, sandy clay loam, or clay loam
Redoximorphic Features (if they occur)--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

C horizon (if it occurs):
Color--hue of 7.5YR to 2.5Y, value of 4 to 7, chroma of 3 to 8
Texture--silt loam or silty clay loam
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

2C horizon;
Color--hue of 7.5YR to 2.5Y, value of 4 to 7, chroma of 3 to 8
Texture--sand, loamy sand, sandy loam, loam, sandy clay loam, or clay loam and may be stratified
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

2Cg horizon;
Color--hue of 5Y to 2.5Y, value of 4 to 7, chroma of 1 or 2, or is neutral with value of 4 to 7
Texture--sand, loamy sand, sandy loam, loam, sandy clay loam, or clay loam and may be stratified
Redoximorphic Features--iron depletions in shades of olive or gray and iron accumulations in shades of red, brown, yellow, or olive

COMPETING SERIES:
Cabool soils--moderately deep to lithic contact and formed in loess underlain by residuum from of chert and sandstone
Chillum soils--have a dense compact 2C horizon that is firm or very firm
Fletcher soils--deep to lithic contact and formed in residuum from phyllite
Gnawbone soils--moderately deep to paralithic contact and formed in residuum from siltstone
Greenbriar soils--deep to lithic contact and formed in a silty mantle underlain by residuum from acid shale and siltstone
Jessietown soils--moderately deep to lithic contact and formed in a silty mantle underlain by residuum from acid shale and siltstone
Matapeake--have a seasonal high water table at a depth greater than 72 inches
Purcellville soils--formed in residuum weathered from diorite, biotite schist, and greenstone schist
Talleyville soils--have sola more than 48 inches thick and formed in a silty mantle underlain by residuum weathered from basic rocks
Wernock soils--moderately deep to paralithic contact and formed in residuum weathered from shale, siltstone, and sandstone
Whitley soils--formed in silty alluvium derived from sandstone, siltstone, and shale
Wrays soils--deep to lithic contact and formed in loess underlain by residuum from siltstone

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Upland ridges and side slopes
Elevation: 0 to 40 feet
Parent Material: Silty eolian deposits underlain by loamy and sandy alluvial and marine sediments
Mean Annual Air Temperature: 52 to 58 degrees F.
Mean Annual Precipitation: 38 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Evesboro soils--excessively drained and have a sandy particle-size control section on higher landforms
Hambrook soils--have a fine-loamy particle-size control section, on similar landforms
Matapeake soils--do not have a seasonal high water above 72 inches, on higher landforms

Mattapex soils--moderately well drained, on lower-lying landforms
Othello soils--poorly drained, on lower-lying landforms
Woodstown soils--moderately well drained and have a fine-loamy particle-size control section, on lower-lying landforms

USE: Most areas are cleared and used for corn, soybeans, small grains and truck crops. Some small areas are in residential or commercial developments or pine plantations.

VEGETATION: Native vegetation includes black oak, hickory, beech, sweetgum, red maple, and loblolly pine.

DISTRIBUTION: Coastal Plain in Maryland, Delaware, and New Jersey

EXTENT: Moderate

SERIES ESTABLISHED: Worcester County, Maryland, 1993

REMARKS: This soil was formerly included in the Matapeake soil series.

Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from 0 to 16 inches (A and E horizon)
Argillic horizon--the zone from 16 to 36 inches (Bt and 2 Bt horizons)
Aquic conditions--the zone from 48 inches to a depth of 80 inches is periodically saturated (endosaturation)

SERIES INTERPRETATION RECORD(S): MD0168

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
MD0168	NASSAWANGO	0- 5	52- 58	190-210	38-48	0-40

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
MD0168	NONE		3.5-6.0	PERCHED	DEC-APR	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
MD0168	0-10	SIL FSL	0- 0	70-100	5-15	5- 15
MD0168	10-16	SIL	0- 0	100-100	5-15	2- 10
MD0168	16-36	SICL SIL	0- 0	100-100	18-30	2- 10
MD0168	36-44	SIL L	0- 0	100-100	10-20	2- 10
MD0168	44-60	LS S	0- 0	90-100	2-10	1- 3

MD0168	60-72	FSL SL SIL			0- 0	70- 95	8-20	1- 3	

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
MD0168	0-10	4.5- 6.5	1.-2.	0- 0	0.6- 2.0	LOW
MD0168	10-16	4.5- 6.5	0.-.5	0- 0	0.6- 2.0	LOW
MD0168	16-36	3.5- 5.5	0.-.5	0- 0	0.2- 0.6	LOW
MD0168	36-44	3.5- 5.5	0.-.5	0- 0	0.6- 2.0	LOW
MD0168	44-60	3.5- 5.5	0.-.5	0- 0	6.0- 20	LOW
MD0168	60-72	3.5- 5.5	0.-.5	0- 0	0.2- 2.0	LOW

LOCATION WOODSTOWN MD+DE NJ PA VA
Established Series
JEB-WDC/Rev. JAK
11/2002

WOODSTOWN SERIES

MLRA(S): 148, 149A, 153A, 153B, 153C, 153D
MLRA OFFICE RESPONSIBLE: Morgantown, West Virginia
DEPTH CLASS: Very deep
DRAINAGE CLASS: Moderately well drained
PERMEABILITY: Moderate
SURFACE RUNOFF: Slow to medium
PARENT MATERIAL: Sandy marine and old alluvial sediments
SLOPE: 0 to 30 percent
MEAN ANNUAL AIR TEMPERATURE (type location): 57 degrees F.
MEAN ANNUAL PRECIPITATION (type location): 50 inches

TAXONOMIC CLASS: Fine-loamy, mixed, active, mesic Aquic Hapludults

TYPICAL PEDON: Woodstown sandy loam, in cropland. (Colors are for moist soil.)

Ap--0 to 7 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak medium granular structure; friable; many very fine and fine roots; strongly acid; clear wavy boundary. (0 to 11 inches thick)

E--7 to 11 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium granular structure; friable; many fine roots; strongly acid; clear wavy boundary. (0 to 10 inches thick)

Bt1--11 to 19 inches; light olive brown (2.5Y 5/6) sandy clay loam; weak medium blocky and subangular blocky structure; friable; slightly sticky, slightly plastic; common roots; common faint clay films on faces of peds; very strongly acid; clear wavy boundary.

Bt2--19 to 29 inches; light olive brown (2.5Y 5/6) sandy clay loam; moderate medium subangular blocky structure; firm; moderately sticky, slightly plastic; few roots; common prominent clay films on faces of peds; common medium distinct light gray (2.5Y 7/2) iron depletions and common medium prominent strong brown (7.5YR 5/8) iron accumulations; very strongly acid; clear wavy boundary. (Combined thickness of the Bt horizon is 10 to 40 inches)

Cg1--29 to 45 inches; light brownish gray (2.5Y 6/2) sandy loam; massive; friable; very few roots; common fine to coarse distinct yellowish brown (10YR 5/4 and 5/6) iron depletions; very strongly acid; clear wavy boundary.

Cg2--45 to 70 inches; light gray (5Y 7/2) loamy sand; single grain; loose; common thick grayish brown (2.5Y 5/2) iron depletions in the shape of horizontal streaks; 10 percent, by volume rounded gravels; extremely acid.

TYPE LOCATION: Dorchester County, Maryland; 0.75 mile northwest of Galestown, 800 feet northeast of bend in Wheatly's Church Rd.

RANGE IN CHARACTERISTICS:
Solum Thickness: 24 to 45 inches
Depth to Bedrock: Greater than 60 inches
Depth to Seasonal High Water Table: 18 to 42 inches, January to April
Rock Fragments: 0 to 15 percent, by volume in the A, E, and B horizon and 0 to 20 in the C horizon, mostly quartz pebbles
Soil Reaction: Extremely acid to strongly acid, throughout the profile, unless limed
Other Features:

RANGE OF INDIVIDUAL HORIZONS:
A horizons (if it occurs):
Color--hue of 10YR or 2.5Y, value of 3 or 4, chroma of 1 to 4
Texture--loam, fine sandy loam, or sandy loam

Ap horizons:
Color--hue of 10YR or 2.5Y, value of 4 to 6, chroma of 2 to 4
Texture--loam, fine sandy loam, or sandy loam

E horizon:
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 2 to 4
Texture--fine sandy loam or sandy loam

BE or BA horizon:
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 4 to 8
Textiure--loam, sandy loam or fine sandy loam

Bt horizon:
Color--hue of 10YR or 2.5Y, value of 5 or 6, chroma of 4 to 8
Texture--sandy clay loam or loam, and less commonly sandy loam, fine sandy loam, or clay loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

BC horizon (if it occurs):
Color--hue of 10YR or 2.5Y, value of 4 to 6, chroma of 4 to 8
Textiure--sandy clay loam, loam, sandy loam, or fine sandy loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

BCg horizon (if it occurs):
Color--hue of 10YR to 5Y, value of 4 to 8, and chroma of 1 or 2, or is neutral with value of 4 to 8
Texture--sandy loam, loamy sand, or sand and may contain thin strata of fine sandy clay loam, silt loam, or sandy clay loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

C horizon:
Color--hue of 10YR to 5Y, value of 4 to 8, and chroma of 3 to 8
Texture--sandy loam, loamy sand, or sand and may contain thin strata of fine sandy clay loam, silt loam, or sandy clay loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

Cg horizon (if it occurs)::
Color--hue of 10YR to 5Y, value of 4 to 8, and chroma of 1 or 2, or is neutral with value of 4 to 8
Texture--sandy loam, loamy sand, or sand and may contain thin strata of fine sandy clay loam, silt loam, or sandy clay loam
Redoximorphic Features--iron depletions in shades of olive, gray, or white and iron accumulations in shades of red, brown, yellow, or olive

COMPETING SERIES:
Adelphia soils--formed in loamy marine sediments that contain 10 to 40 percent, by volume glauconite in the subsoil, on similar landforms
Bigpool soils--formed in alluvium derived from sedimentary rocks
Blairton soils--formed in residuum from gray shale and are moderately deep to hard bedrock
Cotaco soils--formed in alluvium, and colluvium derived from sandstone, siltstone, and shale
Delanco soils--formed in materials weathered from micaceous crystalline rocks
Dillard soils--formed in loamy alluvium in the Blue Ridge Mountains
Fenwick soils--formed in residuum from sandstone, siltstone, and shale and are moderately deep to hard bedrock
Holmdel soils--formed in loamy marine sediments that contain 2 to 10 percent, by volume glauconite in the subsoil, on similar landforms
Trackler(T) soils--formed in colluvium and residuum from fine-grained igneous rocks
Tuscarawas soils--formed in colluvium and residuum derived from clay shale
Wharton soils--formed in residuum from sandstone, siltstone, and shale
Whiteside soils--formed in colluvium in the Southern Appalachian Mountains

GEOGRAPHIC SETTING:
Landscape: Coastal Plain
Landform: Upland marine terraces and old stream terraces
Elevation: 5 to 120 feet
Parent Material: Sandy marine and old alluvial sediments
Mean Annual Air Temperature: 52 to 57 degrees F.
Mean Annual Precipitation: 42 to 48 inches
Frost Free Period: 190 to 210 days

GEOGRAPHICALLY ASSOCIATED SOILS:
Downer soils--well drained and have a coarse-loamy particle-size control section, on slightly higher landforms
Elkton soils--poorly drained and have a fine-silty particle-size control section, on lower-lying landforms
Fallsington soils--poorly drained, on lower-lying landforms
Mattapex soils---have a fine-silty particle-size control section, on similar landforms

Sassafras soils--well drained and have a fine-loamy particle-size control section, on slightly higher landforms

USE: Most of the areas are used for crops including corn, soybeans, small grains, hay, and pasture.

VEGETATION: Native vegetation is oak and hardwoods with some Virginia pine. Loblolly pine occur in the southern part of the series range.

DISTRIBUTION: New Jersey, Delaware, Maryland, the District of Columbia, and the eastern part of Virginia and Pennsylvania.

EXTENT: Large

SERIES ESTABLISHED: Sussex County, Delaware, 1920

REMARKS: Diagnostic horizons and other diagnostic soil characteristics recognized in this pedon are:
Ochric epipedon--the zone from the surface of the soil to a depth of approximately 11 inches (Ap and E horizons)
Argillic horizon--the zone from a depth of approximately 11 to 29 inches (Bt1 and Bt2 horizons)
Aquic conditions--the zone from 19 inches to a depth of 80 inches is periodically saturated (endosaturation)

SERIES INTERPRETATION RECORD(S): MD0036, MD0080 (CLAY SUBSTRATUM)

TABULAR SERIES DATA:

SOI-5	Soil Name	Slope	Airtemp	FrFr/Seas	Precip	Elevation
MD0036	WOODSTOWN	0- 30	52- 57	190-210	42- 48	5- 120
MD0080	WOODSTOWN	0- 8	52- 57	190-210	42- 48	5- 120

SOI-5	FloodL	FloodH	Watertable	Kind	Months	Bedrock	Hardness
MD0036	NONE		1.5-3.5	APPARENT	JAN-APR	>60	
MD0080	NONE		1.5-3.0	APPARENT	FEB-APR	>60	

SOI-5	Depth	Texture	3-Inch	No-10	Clay percent	-CEC-
MD0036	0-11	SL FSL	0- 0	80-100	5-18	2- 10
MD0036	0-11	L	0- 0	85-100	5-18	2- 10
MD0036	11-29	SCL L SL	0- 0	70-100	18-35	1- 5
MD0036	29-70	SR GR-S SL	0- 0	70- 95	5-20	1- 5

MD0080	0-12	SL		0- 0	90-100	10-15	-
MD0080	12-36	SL SCL		0- 0	90-100	10-22	-
MD0080	36-45	LS		0- 0	90-100	2- 8	-
MD0080	45-60	SC		0- 0	90-100	20-40	-

SOI-5	Depth	-pH-	O.M.	Salin	Permeab	Shnk-Swll
MD0036	0-11	3.6- 5.5	1.-2.	0- 0	0.6- 6.0	LOW
MD0036	0-11	3.6- 5.5	1.-2.	0- 0	0.6- 2.0	LOW
MD0036	11-29	3.6- 5.5	0.-.5	0- 0	0.2- 6.0	LOW
MD0036	29-70	3.6- 5.5	0.-.5	0- 0	0.6- 6.0	LOW
MD0080	0-12	3.6- 5.5	.5-2.	0- 0	0.6- 2.0	LOW
MD0080	12-36	3.6- 5.5	.5-2.	0- 0	0.6- 2.0	LOW
MD0080	36-45	3.6- 5.5	.5-2.	0- 0	0.6- 2.0	LOW
MD0080	45-60	3.6- 5.5	.5-1.	0- 0	0.0- 0.2	MODERATE

APPENDIX C: *PHRAGMITES* CONTROL PROGRAM

Large portions of wetland areas at the RRTS have been impacted by the invasion of the common reed (*Phragmites australis*). *Phragmites* is an invasive wetland plant that has formed dense stands in the marshes of the RRTS, crowding out many desirable species and drastically reducing biodiversity and habitat quality. It should be noted that the *Phragmites* invasion is a regional problem that is not linked to specific activities at the installation. By creating a homogenous landscape, *Phragmites* has become a problem throughout the coastal region of the Delaware River. The marshes and shoreline of the Delaware River are important foraging and resting grounds for many migratory bird species, but suitable habitat is lacking due to the overwhelming presence of *Phragmites*.

Executive Order 13112 – Invasive Species, issued on February 3, 1999, requires that federal agencies coordinate complementary, cost-effective activities concerning invasive species with existing organizations addressing invasive species, such as the Federal Interagency Committee for the Management of Noxious and Exotic Weeds and the Committee on Environment and Natural Resources. A large-scale program to reduce *Phragmites* in marshes along the Delaware River has been initiated by DNREC and includes part of the property at the RRTS. The Northern Delaware Wetlands Rehabilitation Program (NDWRP), coordinated by DNREC under the Division of Fish and Wildlife, has initiated the restoration of 48 acres of marsh at the RRTS along Gambles Gut. The DEARNG has cooperated with DNREC in this restoration effort. The program targets monospecific stands of *Phragmites* for herbicide application and controlled burns in order to promote a more heterogeneous marsh community. The Gambles Gut marsh was sprayed by DNREC with Rodeo® (glyphosate), a systemic herbicide that has been approved for use in estuaries and tidal marshes, on September 29, 1998. Application in the late summer or early fall decreases the likelihood that non-target species interspersed in the *Phragmites* stands would be susceptible to the herbicide (Hossler, 1998). Firebreaks were constructed prior to the controlled burns, in order to protect woody species in the upland communities adjacent to Gambles Gut marsh. DNREC conducted controlled burns on February 10 and March 8 of 1999. The burns were only moderately successful, so that approximately 10 acres were successfully burned at the RRTS. The remaining areas of *Phragmites* were targeted for burning by DNREC in late-winter 2000 (Hossler, 1999). Burned open marsh areas at the RRTS will be allowed to regenerate naturally.

Shoreline erosion and stabilization is another management issue addressed by the Wetlands Management Program. The installation includes approximately 4,000 feet of Delaware River shoreline. The shoreline consists of intertidal unconsolidated shore, *Phragmites* tidal marsh, and small patches of emergent *Spartina* tidal marsh beds. Emergent vegetation such as *Spartina* (as well as submerged aquatic vegetation) aids in shoreline stabilization by creating a buffer against wave action, thereby reducing erosion and causing sediments to settle. This in turn improves water clarity and quality. The emergent vegetation also contributes an important source of nutrients for aquatic species and waterfowl, both as living plant material and detritus (USEPA, 1993). Emergent and submerged aquatic vegetation beds in the Delaware River are threatened by nutrient and sediment overloading which reduces the dissolved oxygen concentration and clarity of the water (DRKN, 1999). Although several patches of emergent vegetation exist along the shoreline boundary of the RRTS, these populations need strengthening in order to provide adequate shoreline stabilization and wildlife habitat benefits. Through revegetation and monitoring efforts, the RRTS can improve the success of emergent vegetation along its shoreline.

Photo: *Phragmites* Brackish Tidal Marsh after Early Spring Burn

An additional wetland management concern at the installation is potential lead contamination from historic use of the small arms ranges. A majority of tidal wetlands are located downrange and historically there were no safety berms associated with the ranges. Consequently, past training activities resulted in spent bullets being deposited into these wetlands and into the Delaware River. Currently, all ranges at the installation have safety berms that serve as bullet backstops. These berms are designed to Army specifications and are routinely maintained by the DEARNG.

A study was conducted in 1994 to evaluate the presence of spent bullets in downrange wetland areas at RRTS. The study report indicated that the bullets were only minimally degraded in the water, and had not negatively impacted water quality or habitat (Duffield, 1994). However, the USFWS has expressed additional concerns regarding lead at the installation, including the need for additional information and the need for DNREC to consider potential lead issues during their wetland restoration efforts.

While the DEARNG acknowledges the potential historical lead issues at the installation, activities to address potential lead contamination at active military ranges falls outside the scope of the ARNG's natural resources management planning program. Accordingly, these issues are not addressed in detail in this INRMP. However, an important component of natural resources management at RRTS is to ensure that current training activities do not impact wetlands and that constraints associated with the potential lead contamination be evaluated during implementation of the INRMP activities.

The existing range berms effectively prevent spent bullets from directly entering wetlands and surface waters at and adjacent to the installation. Therefore, stormwater runoff and soil erosion

are the primary lead migration pathways of potential concern. The flat topography and the drainage pattern at the installation help to minimize lead migration from the ranges. Maintenance of vegetative cover on and around the berms, standard berm maintenance practices (e.g., re-packing), and other best management practices also help to minimize berm erosion and runoff. Wetlands Management Goal #3 (see Section 8.6) has been established in this INRMP to continue routine berm inspections and maintenance at RRTS.

The USFWS recommends that any future wildlife enhancement practices be performed only in areas well outside of the historic and current range fans to limit the exposure of wildlife to potential lead contamination. This constraint will be integrated into all future DEARNG management practices at the installation. In addition, the DEARNG will continue to make DNREC and other agencies aware of this constraint to assist in their planning of future wetland restoration efforts.

APPENDIX D: GLOSSARY

GLOSSARY

Annual Training (AT) - A two week active duty training period for the National Guard and Reserve.

Aquatic Macroinvertebrate - Insects and other invertebrate animals found in lakes, streams, ponds, marshes and other surface waters.

Biodiversity - The variety of life and its processes, including living organisms, the differences among them, and the communities and ecosystems in which they occur.

Canopy - The uppermost layer of branches and foliage of forest or a single tree.

Ecosystem - A community of organisms interacting together and their physical environment.

Floodplain - The almost level land forming the floor on either side of a stream in a valley, often subject to flooding.

Hydric Soil - A soil that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. The concept of hydric soils includes soils developed under sufficiently wet conditions to support the growth and regeneration of hydrophytic vegetation.

Hydrophyte - A plant adapted to growing in water, waterlogged soil, or on a substrate that becomes inundated on a regular basis.

Inactive Duty Training (IDT) - Authorized training performed by a member of a Reserve component not on active duty or active duty for training and consisting of regularly scheduled unit training assemblies, additional training assemblies, periods of appropriate duty or equivalent training, and any special additional duties authorized for Reserve component personnel by the Secretary concerned, and performed by them in connection with the prescribed activities of the organization in which they are assigned with or without pay.

Integrated Training Area Management (ITAM) - Military program developed by the Army to integrate training and other mission requirements for land use with sound natural resources management of the land.

Land Condition Trent Analysis (LCTA) - An inventory and monitoring program used to identify training-related impacts to natural and cultural resources.

Land Rehabilitation and Maintenance (LRAM) - A preventive and corrective land rehabilitation and maintenance procedure that reduces the long-term impacts of training and testing on an installation. It mitigates training and testing effects by combining preventive and corrective land rehabilitation, repair, and/or maintenance practices.

Marsh - Type of wetland community characterized by poorly drained mineral soils and by plant life dominated by grasses. The latter characteristic distinguishes a marsh from a swamp (q.v.), whose plant life is dominated by trees.

Mesic - Of, or adapted to, a temperate, moderately moist habitat; neither xeric (dry) nor hydric (wet).

Predation - In animal behavior, the pursuit, capture, and killing of animals for food.

Sediments - Deposits into lakes, wetlands, streams (and overbanks), estuaries, reservoirs, fjords, shallow coastal seas and other bodies of marine or fresh water derived from bedrocks, soils, and organic remains within the drainage basin, though fine particles can also be blown in by winds from distant natural, urban, and industrial sources.

Training Requirements Integration (TRI) - A decision support procedure that integrates all requirements for land use with natural and cultural resources management processes.

Watershed - The complete area from which runoff drains to feed a stream or body of water.

Wetland - An area where saturation or repeated inundation of water is the determining factor in the nature of the soils, as well as the plants and animals living there. Included in the term are marshes, swamps, bogs, fens, bay heads, wet meadows, potholes, sloughs, bayous, river flood plains, estuaries, and lake margins.

APPENDIX E: ACRONYMS

ACRONYMS

AR	Army Regulations
AT	Annual Training
BASH	Bird Air Strike Hazard
BBTS	Bethany Beach Training Site
CEQ	Council on Environmental Quality
COMPAS	Coastal Ocean Management, Planning, and Assessment Systems
CSDGM	Content Standard for Digital Geospatial Metadata
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
DA	Department of the Army
DCMP	Delaware Coastal Management Program
DEANG	Delaware Air National Guard
DEARNG	Delaware Army National Guard
DNREC	Delaware Department of Natural Resources and Environmental Control
DoD	Department of Defense
EA	Environmental Assessment
ECAS	Army National Guard Environmental Compliance Assessment System
EELC	Executive Environmental Leadership Council
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FWPCA	Federal Water Pollution Control Act
GIS	Geographic Information System
GPS	Global Positioning System
GUI	Graphical User Interface
IDT	Inactive Duty Training
INRMP	Integrated Natural Resources Management Plan
ITAM	Integrated Training Area Management
LAN	Local Area Network
MSL	Mean Sea Level
NDWRP	Northern Delaware Wetlands Rehabilitation Program
NEPA	National Environmental Policy Act
NGB	National Guard Bureau
NGB-AEN	Engineering Directorate of the National Guard Bureau
NGB-ARE	Environmental Resources Branch of the National Guard Bureau
NGB-ARO	Operations Directorate of the National Guard Bureau
NHI	Delaware Natural Heritage Inventory
NHP	Delaware Natural Heritage Program
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
	ppt parts per thousand
ROPES	Rugged Outdoor Pursuit Education System
SWP3	Stormwater Pollution Prevention Plan
T&E	Threatened and Endangered Species
TSSDS	Tri-services Spatial Data Standards
USDA	United States Department of Agriculture

USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	United States Geologic Survey

APPENDIX F: REFERENCES

REFERENCES

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APPENDIX G: WORK PLANS

OBJECTIVE 1.1: Reduce Invasive and Noxious Species

Project 1.1.1: Continue to support cooperative efforts with DNREC NDWRP to control *Phragmites* invasions in tidal marsh communities. Evaluate the effectiveness of the current *Phragmites* removal and control methods by January 2010. Use the results of this evaluation to modify the Integrated Pest Management program, if necessary.

Priority: Medium
Estimated Cost: $0
Start Date: December 2009
End Date: January 2010
Responsible Point of Contact: Environmental Program Manager
Program Interaction: None
Staffing Requirements: DEARNG
Cooperative Agreements: DNREC NDWRP
Funding Approved: No additional funding required
Potential Funding Sources: Not applicable

As discussed in Section 5.2, large portions of wetland areas at the RRTS have previously been impacted by the invasion of the common reed (*Phragmites australis*). Executive Order 13112 – Invasive Species, issued on February 3, 1999, requires that federal agencies coordinate complementary, cost-effective activities concerning invasive species with existing organizations addressing invasive species, such as the Federal Interagency Committee for the Management of Noxious and Exotic Weeds and the Committee on Environment and Natural Resources.

Since 1998, DEARNG has been a cooperative partner with DNREC in the Northern Delaware Wetland Rehabilitation Program (NDWRP). DEARNG's current role in these activities is limited to providing site access, equipment storage, logistical support, and information regarding constraints. A description of the NDWRP activities at the RRTS are provided in Section 4.6 and Appendix C. DEARNG will analyze the effectiveness this cooperative effort under Project 1.1.1.

PROJECT 1.1.2: Develop and implement a program to remove other invasive plants (e.g., Japanese honeysuckle, multiflora rose, and oriental bittersweet) from roadside and forest edges using a combination of selective herbicide application and mechanical removal by January 2010.

Priority: Medium
Estimated Cost: $500
Start Date: December 2009
End Date: January 2010
Responsible Point of Contact: Environmental Program Manager
Program Interaction: NGB Conservation
Staffing Requirements: DEARNG, Volunteers
Cooperative Agreements: None
Funding Approved: No
Potential Funding Sources: Environmental Program Management, installation maintenance funds

Project 1.1.2 includes the development and implementation of a program to the control of invasive plants in forested communities at the RRTS. Invasive plants impacting the forest edges and roadside along the western boundary of the RRTS include Japanese honeysuckle, multiflora rose, and oriental bittersweet. Control of invasive plants in these areas should include a combination of selective herbicide use and physical removal. Species specific approaches will be utilized to maximize effectiveness, minimize herbicide use, and minimize disturbance to existing native species. Species-specific fact sheets for selected invasive plants are provided in the Flora PLS in Appendix B. All herbicide applications will be conducted by a DOD-certified applicator in accordance with the NGB Regional Pest Management Plan. Potential sources of labor for physical removal efforts include DEARNG soldiers on weekend training, volunteer groups such as Boy Scouts, and prison inmates that currently assist with grounds maintenance.

OBJECTIVE 1.2: Restore and Protect Tidal Marshes

PROJECT 1.2.1: Create and implement a work plan for using created marshes to stabilize the Delaware River shoreline at the RRTS. This work plan should include restoration methods, implementation procedures, and monitoring methods, and should be fully implemented by December 2010.

Priority: Low
Estimated Cost: $25,000
Start Date: January 2007
End Date: December 2010
Responsible Point of Contact: Environmental Program Manager
Program Interaction: None
Staffing Requirements: Consultant
Cooperative Agreements: None identified at this time
Funding Approved: No
Potential Funding Sources: DOD Legacy Program, State and Federal grant programs

This project involves development and implementation of a shoreline stabilization project using wetlands restoration efforts. Initially, a work plan should be developed detailing specific restoration methods, implementation procedures, and monitoring methods. Detailed mapping of existing *Spartina* beds, conducted by the Corps in 2005, should be incorporated into the DEARNG GIS to serve as a baseline to evaluate the effectiveness of the restoration efforts. It is anticipated that restoration efforts will include planting *Spartina* along the installation's shoreline in areas that are currently unvegetated. Plant materials may be obtained from the existing *Spartina* beds or from commercial sources. All revegetated areas will also be accurately mapped in the GIS so that survival and growth of the planted materials can be evaluated. The initial phase of the project is expected to be conducted over a three-year period, with planting conducted during the first year and monitoring conducted during the second and third years. Success of initial plantings will be evaluated after year three and additional plans developed as necessary.

PROJECT 1.2.2: Develop cooperative agreements with local colleges or universities, Delaware DNREC, or USFWS for tidal marsh monitoring at the RRTS by December 2007. Particular attention should be paid to the effectiveness of the shoreline stabilization marshes from Project 1.2.1 above.

Priority: Low
Estimated Cost: $0
Start Date: January 2007
End Date: December 2007
Responsible Point of Contact: Environmental Program Manager
Program Interaction: None
Staffing Requirements: DEARNG
Cooperative Agreements: None currently in place
Funding Approved: No
Potential Funding Sources: N/A

This project involves the development and approval of cooperative agreements with other environmental resources specialists who have a vested interest in the study of native ecosystems in Delaware. These specialists include professors and graduate students at various colleges and universities, wildlife and vegetation managers for DNREC, and wildlife specialists at the USFWS. Cooperative agreements with these specialists would benefit them by allowing access to the RRTS for monitoring, regulatory, and/or research purposes, and would benefit DEARNG by providing updated data on marsh quality and species diversity. The details of the cooperative agreement (e.g., timing, responsibilities, activities) would be established between the DEARNG Environmental Office and the school or agency, based on the goals and objectives of each party.

OBJECTIVE 1.3: Modify Landscaping at the RRTS to Incorporate Native Plants

PROJECT 1.3.1: Review native landscaping materials, such as ***Delaware Native Plants*** *for Landscaping and Restoration* (available from the Delaware Native Plant Society at: http://www.delawarenativeplants.org/dnps-natplantsbook.htm) by January 2007, and devise a list of acceptable native plants for landscaping at the RRTS by July 2007.

Priority: Low
Estimated Cost: $0
Start Date: July 2006
End Date: July 2007
Responsible Point of Contact: Environmental Program Manager
Program Interaction: NGB Conservation
Staffing Requirements: DEARNG
Cooperative Agreements: None identified at this time
Funding Approved: No
Potential Funding Sources: N/A

This project involves the review of available native landscaping information and the selection of native plants for landscaping at the RRTS. These areas are landscaped with a mixture of native and non-native plants. Replacing non-native species with native plants provides an aesthetically pleasing landscape with reduced need for water, fertilizer, and other care. Information on sources of native plants for landscaping may be obtained through the Delaware Native Plant Society, the US Fish and Wildlife Service, and the Alliance for the Chesapeake Bay.

PROJECT 1.3.2: Identify landscaping needs outside the USPFO and Caretaker's House by January 2008. Identify native plantings suitable for these identified areas, and install by January 2009.

Priority: Low
Estimated Cost**:** $3,000
Start Date: July 2007
End Date: January 2009
Responsible Point of Contact: Environmental Program Manager
Program Interaction: NGB Conservation
Staffing Requirements: DEARNG, Grounds Maintenance staff, volunteers
Cooperative Agreements: None identified at this time
Funding Approved: No
Potential Funding Sources: Installation maintenance funds

This project follows directly on the completion of Project 1.3.1, and involves the installation of native species at the USPFO and Caretaker's House at the RRTS. Plants identified as suitable in Project 1.3.1 should be selected and planted in these locations.

OBJECTIVE 2.1: Enhance Wildlife Habitat

PROJECT 2.1.1: Install wood duck boxes in the tidal marshes of the RRTS by December 2008.

Priority: Medium
Estimated Cost: $50
Start Date: January 2008
End Date: December 2008
Responsible Point of Contact: Environmental Program Manager
Program Interaction: Wetlands and Forest Management
Staffing Requirements: DEARNG staff, cooperative agreements, volunteers
Cooperative Agreements: DENREC NDWRP
Funding Approved: No
Potential Funding Sources: Environmental Program Management, Natural Resources Program, Legacy Program

This project includes the improvement of wildlife habitat will by installation of wood duck nesting boxes in open marsh areas at the RRTS. Since wood ducks are cavity nesters, these nesting boxes provide essential nesting sites where natural alternatives are lacking and protect the nests from predators. The strategic placement of a few boxes throughout the marsh would significantly enhance the wetland habitat quality at the NCRR. Plans for construction, placement, and maintenance of the nesting boxes are provided in Appendix H. Materials for each box can be purchased for approximately $10, and the boxes can be installed through a combination of DEARNG staff and volunteers such as Boy Scout groups. The estimated cost for this goal allows for the purchase of five nesting boxes.

OBJECTIVE 2.2: Improve Wildlife Monitoring Program

PROJECT 2.2.1: Develop cooperative agreements with local colleges or universities, Delaware DNREC, or USFWS for wildlife population and habitat quality monitoring at the RRTS by December 2008.

Priority: Low
Estimated Cost: $0

Start Date: January 2008
End Date: December 2008
Responsible Point of Contact: Environmental Program Manager
Program Interaction: None
Staffing Requirements: DEARNG
Cooperative Agreements: None currently in place
Funding Approved: No
Potential Funding Sources: N/A

This project involves the development and approval of cooperative agreements with other environmental resources specialists who have a vested interest in the study of native ecosystems in Delaware. These specialists include professors and graduate students at various colleges and universities, wildlife and vegetation managers for DNREC, and wildlife specialists at the USFWS. Cooperative agreements with these specialists would benefit them by allowing access to the RRTS for monitoring, regulatory, and/or research purposes, and would benefit DEARNG by providing updated data on marsh quality and species diversity. The details of the cooperative agreement (e.g., timing, responsibilities, activities) would be established between the DEARNG Environmental Office and the school or agency, based on the goals and objectives of each party.

Planned Projects Updated 2021 (Subject to Funding Availability)

Program/ Management Area	Objectives and Projects to Achieve Objectives	Time Frame	Method[1]	Status
Geographic Information System (GIS)	**Objective 1a:** Maintain/Update Current GIS Data			
	Update GIS layers upon completion of new construction.	Estimated 2024	IH / C	Ongoing
Fish and Wildlife Management Program	**Objective 2a:** Enhance Wildlife Habitat for Wood Ducks			
	Continue to monitor wood duck boxes for seasonal issues.	Annually	IH	Ongoing
	Evaluate possibility of installing additional boxes.	2021	IH	Ongoing
	Objective 2b: Improve Wildlife Monitoring Program			
	Develop agreements with local educational institutions, DNREC, or USFWS for monitoring wildlife.	2021	IH	Ongoing
Threatened and Endangered Species Program	**Objective 3a:** Support Endangered Bats Susceptible to White-Nose Syndrome			
	Review contractor proposals and evaluate funding to conduct a bat survey.	2019	C	Completed-2019
	Upon completion of the bat survey, determine if additional action is necessary to control white-nose syndrome.	Dependent on Bat Survey	IH / C	N/A
Wetlands Management Program	**Objective 4a:** Preserve Wetlands Habitat			
	Evaluate status of *Phragmites* encroachment along wetlands annually.	Annually	IH	Ongoing
	Continue to manage noxious weeds at RRTS per the IPMP.	Seasonally	IH	Ongoing
	Evaluate the potential of a living shoreline project.	2023	IH	
	Objective 4b: Collect Data to Restore and Protect Tidal Marshes			
	Monitor wetlands at RRTS.	By 2025	IH	
Grounds Maintenance Program	**Objective 5a:** Reduce Invasive and Noxious Species at RRTS			
	Continue to implement the IPMP to remove invasive plants.	Seasonally	IH	Ongoing
	Objective 5b: Maintain stormwater drainage			
	Repair stormwater drainage to ensure positive flow.	Estimated 2023	IH	
Forest Management Program	**Objective 6a:** Preserve Forested Habitat			
	Evaluate status of *Phragmites* encroachment along forest edges annually.	Annually	IH	Ongoing
	If deemed necessary, evaluate effectiveness of controlled burns to mitigate *Phragmites*.	Dependent on Evaluation	IH	
Honey Bee and Pollinator Program	**Objective 7a:** Support Honey Bee Population			
	Continue to institute pollinator program and maintain hives.	Seasonally	IH	Ongoing
	Evaluate and replenish bee hives if necessary.	Seasonally	IH	Ongoing
	Objective 7b: Enhance Pollinator Habitat			
	Continue to maintain previously installed vegetable gardens to benefit pollinators.	Seasonally	IH	Ongoing
	Develop list of native pollinator friendly plants to be planted throughout the installation.	2020	IH	

[1] Probable method of conducting project: C = Contract; IH = In-House

Planned Projects Updated 2021 (Subject to Funding Availability)

Program/ Management Area	Objectives and Projects to Achieve Objectives	Time Frame	Method[1]	Status
Environmental Awareness Program	**Objective 8a:** Educate Staff on Environmental Awareness			
	Continue to provide annual Environmental Awareness training.	Annually	IH	Ongoing

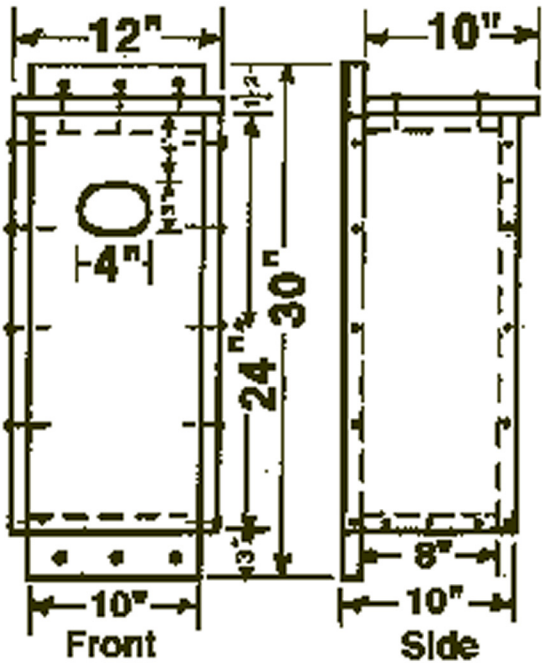
[1] Probable method of conducting project: C = Contract; IH = In-House

APPENDIX H: WOOD DUCK NESTING BOXES

DIY | Wood Duck Nest Boxes *and suggestions for placement*

MATERIALS LIST

- Rough 1" Lumber 10' - 10"
- Back 30" x 10" and Front 24" x 10"
- Sides 24" x 10"
- Bottom 8" x 10"
- Lid 12" x 10"
- Lid Cleat 8" x 10"
- Nails - Galvanized
- Size 8d - 13 per side & 3 in front = 29 total
- Size 6d - 6 in lid = 6 total



Unlike other waterfowl nesting in Oregon, wood ducks almost always seek a tree cavity in which to deposit their eggs. The nesting tree will usually border a stream or lake, but woodies may nest a mile or more from water. The lack of suitable natural nesting sites has led to the construction of artificial boxes which may be placed in areas used by wood ducks. Of hundreds already placed in western Oregon, wood ducks have used a high percentage. Others are used by owls, squirrels and bees. To achieve nesting success, a four-inch layer of sawdust or wood shavings must be put on the floor of the box.

PLANS AND SPECIFICATIONS

1. Use rough lumber: weathered cedar preferred - do not paint. If smooth or planed wood is used, tack screen inside box from floor to hole (rough wood or screen is necessary for ducklings to climb out).
2. Hole: Four inches wide, three inches high, oval, located four inches from top.
3. Bottom: Bore two or three one-quarter inch holes for drainage.
4. Back board: Extend back board several inches above and below to facilitate fastening to tree or pole.

SUGGESTIONS FOR PLACEMENT

1. Nesting box may be placed in a tree. It should be at least 15 feet above the ground and faced toward the water but away from prevailing winds, if possible.
2. A living tree should be chosen since dead trees are more likely to be blown down. The nesting box should be turned so that its entrance hole is not obstructed by branches.
3. If box is placed on a post in the water, it should be above high water danger. This location is good since it eliminates the danger from ground predators.

APPENDIX I: INVASIVE SPECIES FACTSHEETS

Common Reed (*Phragmites australis*) Fact Sheet

Common reed is a tall grass that inhabits wet areas like brackish and freshwater marshes, riverbanks, lakeshores, ditches and dredge spoil areas. Native and introduced forms of Phragmites occur in the United States. Researchers believe that introduced European forms are the aggressive invasives that have replaced much of our native reed. Common reed threatens by displacing native plants and forming monocultures in otherwise biologically diverse natural wetlands. It spreads by seed and strong vegetative growth and is very difficult to control once established. http://www.invasive.org/eastern/midatlantic/phau.html

Seed Head:

Joseph McCauley, U.S. Fish and Wildlife Service, www.forestryimages.org

Plant Habit:

Bernd Blossey, Cornell University, www.forestryimages.org

Oriental Bittersweet (*Celastrus orbiculatus*) Fact Sheet

Oriental bittersweet is a deciduous, climbing, woody vine that can grow to lengths of 60 ft. The alternate, elliptical leaves are light green in color. Small, inconspicuous, axillary flowers give way to round green fruit which ripen and split to reveal showy scarlet berries that persist into winter. It closely resembles American bittersweet (*Celastrus scandens*) but can be distinguished because American bittersweet has flowers and fruits in terminals rather than axillary along the stem. Oriental bittersweet is commonly found through the southern Appalachians in old house sites, fields, and road edges. Some shade tolerance allows it to also grow in open forests. Prolific vine growth allows it to encircle trees and girdle them. It also can completely cover other vegetation and shade, out-compete and kill even large trees. It can be dispersed widely and quickly due to the berries being eaten and spread by birds. Oriental bittersweet was introduced from China around 1860 as an ornamental. It has also been shown to hybridize with American bittersweet, potentially leading to a loss of genetic identity.
http://www.invasive.org/browse/subject.cfm?sub=3012

Foliage and Twigs:

James H. Miller, USDA Forest Service, www.forestryimages.org

Vine and Bark:

James H. Miller, USDA Forest Service, www.forestryimages.org

Fruit:

Leslie J. Mehrhoff, University of Connecticut, www.forestryimages.org

Multiflora Rose (*Rosa multiflora*) Fact Sheet

Multiflora rose is a multi-stemmed thorny, perennial shrub that grows up to 15 feet tall. The stems are arcing canes which are round in cross section. Small white-red flowers or rose hips (fruit) occur in clusters abundantly on the plant. Leaves are pinnately compound with 7-9 leaflets. Multiflora rose is easily distinguished from other wild roses by the feathery, fringed bract located at the base of each leaf. Multifora rose forms impenetrable thickets in pastures, fields and forest edges. It restricts human, livestock and wildlife movement and displaces native vegetation. Multiflora rose is native to Asia and was first introduced to America in 1866 as rootstock for ornamental roses. During the mid 1900s it was widely planted as a "living fence" for livestock control. http://www.invasive.org/browse/subject.cfm?sub=3071

Plant Habit:

Randy Westbrooks, U.S. Geological Survey, www.forestryimages.org

Twigs and Shoots:

James H. Miller, USDA Forest Service, www.forestryimages.org

Leaves:

James H. Miller, USDA Forest Service, www.forestryimages.org

Leaf Base:

James H. Miller, USDA Forest Service, www.forestryimages.org

Flower:

James H. Miller, USDA Forest Service, www.forestryimages.org

Fruit (Hips):

James H. Miller, USDA Forest Service, www.forestryimages.org

Japanese Honeysuckle (*Lonicera japonica*) Fact Sheet

Japanese honeysuckle is an evergreen to semi-evergreen vine that can be found either trailing or climbing to heights of over 80 feet. It has opposite, oval shaped leaves that are 1 to 2.5 inches long and showy, fragrant, tubular flowers that are whitish-pink to yellow in color. Japanese honeysuckle invades a variety of habitats including forest floors and canopies, roadsides, wetlands, and disturbed areas. It can girdle small saplings by twining around them and can form dense mats in the canopies of trees, shading everything below. A native of eastern Asia, it was first introduced into America in 1806 in Long Island, NY. Japanese honeysuckle has been planted widely throughout the United States as an ornamental, for erosion control, and for wildlife habitat.
http://www.invasive.org/browse/subject.cfm?sub=3039

Plant Habit (Spreading):

James R. Allison, Georgia Department of Natural Resources, www.forestryimages.org

Flowers:

Chuck Bargeron, The University of Georgia, www.forestryimages.org

Leaves / Habit (Trailing):

James H. Miller, USDA Forest Service, www.forestryimages.org

Bark:

James H. Miller, USDA Forest Service, www.forestryimages.org

Poison Ivy (*Toxicodendron radicans*) Fact Sheet

Poison ivy is a woody vine with 2-4 in (5-10 cm) leaflets in groups of three. Poison ivy clings to tree trunks and other vertical surfaces with hairlike aerial rootlets which grow out of the stem. If a climbing surface isn't available, poison-ivy will grow as a free-standing shrub that looks a lot like its relative poison oak (*T. pubescens*). The attractive white berries are 1/4 in (0.6 cm) in diameter. These hang in clusters and are relished by birds. The leaves of poison-ivy turn shades of red and purple in fall. *Toxicodendron radicans* is native throughout North America east of the Rockies where it grows almost anywhere, in forests, swamps and fields.

Vine, showing aerial rootlets:

James H. Miller, USDA Forest Service, www.forestryimages.org

Fruit:

James H. Miller, USDA Forest Service, www.forestryimages.org

Leaves:

Ted Bodner, Southern Weed Science Society, www.forestryimages.org

Aspect, showing leaves and flowers:

Charles T. Bryson, USDA Agricultural Research Service, www.forestryimages.org